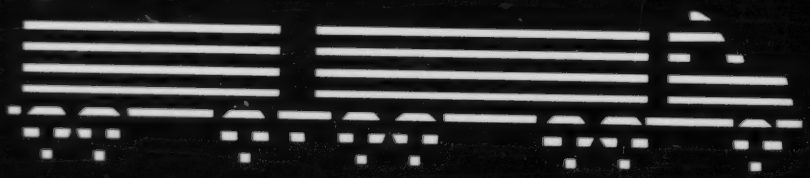
Canada

TP 8480E



STUDY OF VEHICLE WEIGHT AND DIMENSION REGULATIONS AND CANADA'S TRUCKING INDUSTRY

Final Report

CA1
DTC 801
87
V28
c.2

Transportation
Development
Centre

88-00313/

TP 8480E

Library and Information Centre / Centre de Documentation (GSLA)
RECEIVED - REÇU LE
JUL 20 1987
Transport Canada / Transports Canada

VEHICLE WEIGHT & DIMENSION REGULATIONS AND CANADA'S TRUCKING INDUSTRY

FINAL REPORT

by

F. P. Nix
University of Toronto/York University
Joint Program in Transportation

Prepared for
Transportation Development Centre
Transport Canada

April 1987

The contents of this report reflect the views of the authors and not necessarily the official view or opinions of the Transportation Development Centre of Transport Canada.

Transport Canada / Transports Canada

Development / Developpement

REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
TP 8480E	6374	

4. Title and Subtitle	5. Report Date
Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry - Final Report	April 1987
	6. Performing Organization Report No.

7. Author(s)	8. Transport Canada File No.
F.P. Nix, A.M. Clayton, B.G. Bisson, G.A. Sparks	D1465-421-3

9. Performing Organization Name and Address	10. DSS File No.
University of Toronto/York University Joint Program in Transportation 4700 Keele Street Downsview, Ontario M3J 1P3	14SD.T8200-4-4567
	11. DSS or Transport Canada Contract No.
	OSD84-00286

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Transportation Development Centre (TDC) 200 Dorchester Blvd. West Suite 601, West Tower Montreal, Quebec H2Z 1X4	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes	16. TDC Project Officer
	R.L. Sabounghi

17. Abstract

This study attempts to put together an understanding of how the twelve sets of weight and dimension regulations in Canada work, where the major differences are, and what the implications are. The report describes the impact of the regulations in terms of how they affect the design of truck combinations, how the vehicles that result affect trucking costs and rates, how the different regulations have affected the characteristics of truck fleets in various parts of the country, and how individual operators make decisions in terms of their own operations.

The study concludes that although the great diversity in regulations has had a detectable impact on the characteristics of fleets and transportation costs, there is no simple one-to-one relationship between regulations and trucking and that "rationalizing" the regulations will not necessarily mean "greater uniformity" in all cases.

18. Key Words	19. Distribution Statement
Truck dimensions, weights, provincial regulations, Canada.	Limited number of copies are available from the Transportation Development Centre.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified	xi, 97	-

TDC CDT 79-005
Rev 86

Canada

Transports Canada / Transport Canada
Développement / Development

FORMULE DOCUMENTAIRE DU RAPPORT

1 N° du rapport Transports Canada	2 N° de l'étude — CDT	3 N° de catalogue du destinataire
TP 8480E	6374	

4 Titre et sous-titre	5 Date du rapport
Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry - Final Report	avril 1987
	6 N° du rapport de l'organisme executant

7 Auteur(s)	8 N° de dossier Transports Canada
F.P. Nix, A.M. Clayton, B.G. Bisson, G.A. Sparks	D1465-421-3

9 Nom et adresse de l'organisme executant	10 N° de dossier — ASC
University of Toronto/York University Joint Program in Transportation 4700 Keele Street Downsview, Ontario M3J 1P3	14SD.T8200-4-4567
	11 N° de contrat — ASC ou Transports Canada
	OSD84-00286

12 Nom et adresse de l'organisme parrain	13 Genre de rapport et période visée
Centre de développement des transports (CDT) 200 ouest, boul. Dorchester Suite 601, tour ouest Montréal (Québec) H2Z 1X4	Rapport final
	14 Code de l'organisme parrain

15 Remarques additionnelles	16 Agent de projet — CDT
	R.L. Sabounghi

17 Resume

Cette étude tente d'élucider les principes et le fonctionnement des douze réglementations en vigueur au Canada en matière de poids et de dimensions des véhicules de transport routier et de mettre en évidence les divergences majeures et leurs conséquences. Le rapport décrit l'impact des réglementations sur les configurations des ensembles routiers, montre dans quelle mesure ces configurations influent sur les coûts et tarifs de l'industrie et dans quelle mesure les diverses réglementations ont influencé la composition des parcs de camions dans les diverses régions du pays, et explique comment ces réglementations influent sur les décisions de gestion et d'exploitation prises par divers exploitants.

L'étude conclut qu'en dépit de l'impact décelable des diverses réglementations sur la composition des parcs de camions et sur les coûts du transport, on ne peut affirmer qu'une réglementation donnée explique à elle seule la situation de l'industrie du camionnage dans la province concernée. Elle conclut également que la "rationalisation" des réglementations ne signifiera pas nécessairement une plus grande uniformité dans tous les cas.

18 Mots-clés	19 Diffusion
Dimensions, poids, réglementation provinciale, Canada, camions.	Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

20 Classification de sécurité (de ce rapport)	21 Classification de sécurité (de cette page)	22 Nombre de pages	23 Prix
non classifié	non classifiée	xi, 97	-

Canada

Summary

This research originated at the time of the announcement of the major study by the Roads and Transportation Association of Canada and the Canadian Council of Motor Transport Administrators (RTAC/CCMTA) study into heavy vehicle weight and dimension regulations. At the time, it was felt that there was not enough understanding about the complexity of the relationship between the regulations and trucking.

Since the relationship between weight and dimension regulations and trucking is only part of the information required to formulate optimal regulations, this study cannot by itself lead to any specific recommendations regarding policy (larger trucks? uniform regulations? the axle- spread regulations in one province versus those in another?). Rather, the perspective adopted here has been: this, for better or worse, is the regulatory environment; this is its impact on trucking; hopefully this relationship will be considered when the "technical" factors developed from the RTAC/CCMTA study are incorporated into new regulations.

The focus of the research has been to put together an understanding of how the twelve sets of weight and dimension regulations in Canada work, where the major differences are, and what the implications for truck operators are. A separate report, *Vehicle Weight and Dimension Regulations and Canada's Trucking Industry : The Regulations (TP 8481E, April 1987)*, is a detailed manual describing and analyzing the regulations as of the winter of 1986/87. The material in this report describes the impact of these regulations in terms of how the different regulations affect the design of truck combinations, how the trucks that result affect trucking costs and rates, how the different regulations have affected the characteristics of truck fleets in various parts of the country, and how individual operators make decisions in terms of their own operations.

The findings are: (i) there is a great deal of diversity in the regulations, but only the largest trucks which constitute a small, albeit important, portion of the total fleet are affected; (ii) regulatory changes, by allowing larger trucks, have had a significant impact on fleets and transportation costs; (iii) the differences between the various regulations do have a detectable impact on the characteristics of fleets and transportation costs, but not all trucking and not all commodity flows appear to be greatly affected by regulatory differences; (iv) there is no simple one-to-one relationship between regulations (or changes in regulations) and trucking (or changes in trucking); (v) there are several issues, such as enforcement, special permitting, and other factors that are important but that remain under-researched; (vi) the process of regulatory change, which has often aimed at greater uniformity, has produced some unexpected results; (vii) there is a shortage of "basic" research on trucking which has hampered the efforts to assess the impact of alternative regulations; (viii) there are a number of reasons why there has been (and may continue to be) regulatory conflict in Canada including divided jurisdictional responsibilities, divided technical responsibilities, different problems or needs in different regions, an accelerating process of regulatory fragmentation, different philosophical approaches, ordinary human failings, and some differences between the de jure and de facto nature of the regulations; and (ix) "rationalizing" the regulations will not necessarily mean, nor should it mean ,"greater uniformity" in all cases.

Sommaire

La présente recherche a été entreprise lorsque l'Association des routes et des transports du Canada et le Conseil canadien des administrateurs en transport motorisé (ARTC/CCATM) ont annoncé leur intention de mener une étude approfondie sur les réglementations concernant les poids et dimensions des véhicules lourds. À l'époque, l'opinion était que la complexité des rapports entre cette réglementation et l'industrie du camionnage n'était pas très bien comprise.

Étant donné que cet aspect de la question ne représente qu'une partie de l'information nécessaire à la formulation d'une réglementation raisonnable, cette seule recherche ne peut mener à des recommandations précises, par exemple, sur l'opportunité d'autoriser des camions plus gros, d'uniformiser les réglementations et de privilégier les règlements sur l'écartement des essieux, d'une province plutôt que d'une autre. Devant cette constatation, il a été décidé de s'en tenir à une description brute de la situation en matière de réglementation et de l'impact sur le camionnage; et en espérant qu'il en sera tenu compte au moment d'incorporer à la nouvelle réglementation les facteurs "techniques" tirés de l'étude de l'ARTC/CCATM.

Par cette recherche, on a surtout tenté de faire la lumière sur les divergences majeures entre les douze réglementations en vigueur au Canada et de déterminer quelles en étaient les répercussions sur les exploitants. Le document intitulé *"Vehicle Weight & Dimension Regulations and Canada's Trucking: The Regulations" (TP 8481E, avril 1987)* décrit et analyse les réglementations en question, faisant le point, fin 1986, début 1987. Le rapport final précise: 1) l'impact de ces réglementations diverses sur les configurations des ensembles routiers; 2) dans quelle mesure ces configurations influent sur les coûts et les tarifs de l'industrie; 3) comment les diverses réglementations affectent la composition des parcs de camions dans les diverses régions du pays, et 4) comment les exploitants prennent leurs décisions en matière d'exploitation.

Les conclusions sont les suivantes: i) les diverses réglementations comportent un grand nombre de divergences, mais seulement en ce qui a trait aux camions les plus gros, lesquels constituent une faible part (quoique importante) du parc total; ii) les modifications apportées aux réglementations pour permettre des camions plus gros, ont eu un impact considérable sur les parcs de camions et sur les coûts du transport; iii) les divergences entre les diverses réglementations ont effectivement un impact décelable sur la composition des parcs et les coûts du transport, mais il semble que cela touche surtout certaines opérations de camionnage et certaines catégories de marchandises; iv) une réglementation (ou sa modification) ne peut expliquer à elle seule la situation du camionnage dans la province correspondante; v) en effet, plusieurs autres facteurs entrent en jeu, par exemple la rigueur d'application des règlements, les permis spéciaux, et leur influence n'a pas encore été élucidée; vi) les modifications ont donné des résultats inattendus; vii) trop peu de recherche "fondamentale" a été faite sur le camionnage, rendant difficile l'évaluation de l'impact des solutions de rechange; viii) les raisons qui expliquent l'actuelle diversité des réglementations (et la probabilité qu'elle se perpétue) sont nombreuses, notamment le fractionnement des compétences législatives et

techniques, la disparité des problèmes ou des besoins d'une région à l'autre, un processus de fragmentation des règlements, des positions de principe divergentes, des défaillances humaines et certaines divergences en fait et en droit dans la nature des règlements; et enfin, ix) la "rationalisation" de la réglementation ne signifiera pas, ni ne devrait nécessairement signifier "une plus grande uniformité" dans tous les cas.

Acknowledgements

This report is a synthesis of work done by a research team in seven background papers. In addition to the author, the research team included Al Clayton from the University of Manitoba, Gordon Sparks from the University of Saskatchewan, and Barry Bisson from the University of New Brunswick. The work of these team members is gratefully acknowledged.

Various people within the provincial and territorial governments assisted in the preparation of a companion report, *Vehicle Weight & Dimension Regulations and Canada's Trucking Industry: the Regulations*, and their assistance is acknowledged in that report.

The 40 carriers and/or trailer manufacturers whose case studies are documented in *Vehicle Weight & Dimension Regulations and Canada's Trucking Industry: Case Histories* deserve a special mention for their patience in explaining to members of the research team how they worked within various regulatory environments.

Table of Contents

		page
1.	**Introduction**	1
1.1	Purpose	1
1.2	Background	1
1.3	Study Outline	2
1.4	Report Organization	3
2.	**Overview**	4
3.	**Trucking and Roads**	8
4.	**Previous Research**	10
5.	**The Regulations**	12
5.1	Introduction	12
5.2	Standard Weight and Dimension Regulations	12
5.3	Major Differences	15
5.4	Changes Through Time	18
5.5	Non-Standard Regulations	19
5.6	Enforcement Considerations	21
6.	**Regulations and Trucking Part I: Paper Differences**	22
6.1	Introduction	22
6.2	The Standard Tractor-Semitrailer	22
6.3	Maximizing Cube	24
6.3.1	Tractor-Semitrailer	24
6.3.2	Tractor-Semitrailer with Drome	25
6.3.3	Double-Trailer Configurations	25
6.4	Maximizing Load	27
6.4.1	Straight Trucks	27
6.4.2	Tractor-Semitrailers	30
6.4.3	All Combinations	32
7.	**Regulations and Trucking Part II: Cost Considerations**	36
7.1	Truck Size and Trucking Costs	36
7.2	Weight and Dimension Regulations and Shipping Costs	37
7.2.1	Saskatchewan Petroleum Haulers	37
7.2.2	Statistics Canada Data	40
7.3	Summary	52
8.	**Regulations and Trucking Part III: Fleet Characteristics**	53
8.1	Introduction	53
8.2	The Data	53
8.3	Observations	56
8.3.1	The Large Truck Fleet	56
8.3.2	Growth Rate of Large Truck Combinations	58
8.3.3	Extra versus Intraprovincial Trucks	59

page

8.3.4 For-hire Trucks 59
8.3.5 Straight Trucks 60
8.3.6 Truck-Plus-Trailer Configurations 61
8.3.7 Tractor-Semitrailers 61
8.3.8 Trains 62
8.3.9 Maximum GVW Limits 62
8.3.10 Inter-jurisdictional Differences 62
8.3.11 Temporal Considerations 63
8.3.12 Factors Other Than Weight and Dimension Regulations 63
8.3.13 The Impact of the Western Highway Strengthening Program 64
8.3.14 The Impact of the Atlantic Highway Strengthening Program 65

9. Regulations and Trucking Part IV: Fleet Selection 66
9.1 Introduction 66
9.2 The Impact of Single Regulatory Regimes 66
9.2.1 Petroleum Haulers 67
9.2.2 LTL General Freight Carriers 69
9.3 The Impact of Multiple Canadian Regulations 70
9.3.1 Different Regulations Within One Jurisdiction 70
9.3.2 Different Regulations Among Similar Jurisdictions 71
9.3.3 Different Regulations Between Dissimilar Regions 71
9.3.4 Different Regulations Across Canada 73
9.4 The Impact of U.S. Regulations 73
9.5 The Impact of Changes in Regulations 74
9.5.1 The Rate of Adjustment 74
9.5.2 Expectations 75
9.5.3 The Scale of Change 75
9.5.4 Inefficiencies Resulting From the Process of Change 76
9.6 The Impact of Regulations Given Enforcement Considerations 76
9.7 The Impact of Other Factors on Fleet Selection 78

10. Observations 81
10.1 Diversity in Current Regulations 81
10.2 Impact of Changing Regulations 82
10.3 Impact of Different Regulations 84
10.4 The Role of Weight and Dimension Regulations 85
10.5 Unresolved Issues 86
10.6 The Process of Regulatory Change 87
10.7 The Inadequacy of Basic Research 87
10.8 The Reason for Regulatory Conflict 88
10.9 The Need for Uniformity 89

References 90
Glossary 94

List of Tables

		page
Table 1	Weight and Dimension Regulations	14
Table 2	Standard 3-S2, All Jurisdictions	23
Table 3	Standard 3-S2, Ten Jurisdictions	23
Table4	Double 28' Pups, Seven Jurisdictions	26
Table 5	Double 28' Pups, No Kingpin-Rear Limit	26
Table 6	Straight Trucks: Maximum Load	29
Table 7	Given Straight Truck, Different Regulations	30
Table 8	Tractor-Semitrailers: Maximum Loads	31
Table 9	Given 3-S2 & 3-S3 Configurations, Cross-Canada Haul	33
Table 10	Maximum Loads: Any Combination	34
Table 11	Saskatchewan Petroleum Product Trucking Rates	39
Table 12	Saskatchewan Petroleum Product Trucking Rates - 1981 dollars (lowest contract rates, carrier-supplied trailers)	39
Table 13	Grain (frequency distribution, by TL shipment size)	43
Table 14	Logs & Pulpwood (frequency distribution, by TL shipment size)	45
Table 15	Pulpwood Chips (frequency distribution, by TL shipment size)	45
Table 16	Sand, Gravel, and Crude Stone (frequency distribution, by TL shipment size)	47
Table 17	Lumber and Sawn Timber (frequency distribution, by TL shipment size)	48
Table 18	Gasoline (frequency distribution, by TL shipment size)	50
Table 19	Distribution of Resident Trucks X RGVW (% distribution of registrations)	54
Table 20	Distribution of Non-Resident Trucks X RGVW (% distribution of registrations)	55
Table 21	Distribution of Trucks by Configuration (% distribution of road-side observations)	56
Table 22	Changes in Distribution of Trucks by Configuration (% distribution of road-side observations)	56
Table 23	Distribution of GVWs (% distribution of road-side observations)	57
Table 24	Distribution of RGVWs (% distribution of road-side observations)	58
Table 25	Distribution of Payloads (% distribution of road-side observations)	59
Table 26	Typical Petroleum Tank Trucks	68
Table 27	LTL General Freight: Available Trailer Length	69
Table 28	Seven-axle B-train, Ontario - Western Canada	72

1. Introduction

1.1 PURPOSE

The purpose of this study is to explore the relationship between vehicle weight and dimension regulations and trucking. As such, there is no intention to produce specific recommendations: should gross vehicle weight limits be raised or lowered? should tandem-axle limits be set similar to those in Ontario or those in Saskatchewan? should all provinces adopt uniform regulations? what is the trade-off between larger trucks and road costs? etc. Nevertheless, these policy issues are the "raison d'être" for this research, as is explained below.

1.2 BACKGROUND

In 1983, the Roads and Transportation Association of Canada and the Canadian Council of Motor Transport Administrators announced a major study to investigate aspects of weight and dimension regulations (the "RTAC/CCMTA study"). The two main topics to be investigated were pavements (their response to heavy loads) and vehicle stability and control (issues of road safety). Secondary issues included bridges and axle spacings/loadings, heavy vehicles and traffic, and economic impacts. The study was to resolve some of these issues so that more uniform regulations could be introduced in all twelve provinces and territories.

Although this announcement did much to satisfy the research requirements surrounding weight and dimension regulations, one aspect of the subject was being neglected. This was the relationship between the regulations on the one hand and truck activity on the other. This is often viewed as the "benefit" side of the issue in research into the merits of increasing and/or changing regulations (the road system -- pavements, structures, traffic and safety -- are viewed as the "cost" side in this perspective). Up to this time, and to some extent still to this day, there has been a tendency because of a lack of data to make over-simplistic assumptions about this relationship: "increase allowable weights by ten tonnes and all freight moves in trucks that are ten tonnes heavier at a cost that can be shown to be XX% lower."

With the help of the Research & Development Branch of Transport Canada, this project was initiated through a contract with the Transportation Development Centre. Unlike past work, which typically evaluates specific regulatory proposals, this project was not designed to produce any answers as to which particular regulations are better or worse than others. In fact, given that only the impact on trucking and, through truck costs, the impact on shippers fell within the scope of this research, it would not have been possible to provide fully-developed policy recommendations.

Rather, the purpose here is to examine the complex inter-relationships between regulations on the one hand, including multiple sets of regulations, and trucking activity on the other -- fleet characteristics, choosing vehicles for particular regulatory regimes, costs, operations, and trucking rates. The hope is, of course,

that this will provide greater insights into relationships that are often assumed in other research.

1.3 STUDY OUTLINE

The research was divided into seven tasks and working papers. Some of these papers are more formal than others and two have been printed and distributed as separate reports. The seven tasks are:

- TASK 1: The first task was to describe and analyze the twelve sets of weight and dimension regulations. The working paper, "Analysis of Canada's Vehicle Weight and Dimension Regulations", has been reviewed by most provinces and territories and updated to the fall/winter of 1986/87.[1] With these revisions, this paper now constitutes a separate report, Vehicle Weight & Dimension Regulations and Canada's Trucking Industry: The Regulations.

- TASK 2: The second working paper contains a critique of previous Canadian research into the issue of the benefits associated with changing weight and dimension regulations (ie, allowing larger or heavier trucks).[2] Aspects of this have been incorporated into Part 4 of this report.

- TASK 3: The third task was "procedural" in that it investigated the availability of data in order to determine whether or not the research should continue. [3]

- TASK 4: One of the difficulties in any truck-related research is the paucity of data on the characteristics of the fleet. The fourth task took the available vehicle registration and roadside survey data and produced a data base of fleet characteristics. There are still problems with this data, but at least it is now possible to put together some information on the fleet that makes up the largest freight mode in Canada. Aspects of this work are contained in Part 8. [4]

- TASK 5: This task examined the relationship between trucking costs and weight and dimension regulations; aspects of it have been incorporated into Part 7. [5]

- TASK 6: The sixth task consisted of a series of visits and/or interviews with truck operators, trailer manufacturers, and weigh scales. The intent was to document specific responses to various weight and dimension regulations. These case studies are described in Vehicle Weight & Dimension Regulations and Canada's Trucking Industry: Case Histories, which has been published by the Transportation Development Centre as a separate report. The overview from this working paper [6] has been incorporated with some revisions into Part 9 of this report.

- TASK 7: In the final working paper, two approaches were used to measure the impact of different regulations (either over time or in different jurisdictions) on shippers. [7] A summary of this appears in Part 7.

1.4 REPORT ORGANIZATION

The report is organized as follows:

- PART 2: An overview of the issues surrounding the subject of weight and dimension regulations is provided. It is argued that the subject has to be seen as a full system with many complex inter-relationships. Most research, this effort included, only examines pieces of the system.

- PART 3: To understand the significance of this subject, it is necessary to consider the current information on trucking and roads. The sheer size of trucking activity and the size of the public road network means that even small changes to (or mistakes in) weight and dimension regulations can have immense consequences. Oddly, much of the current focus on changing regulations to accommodate interprovincial trucking activity misses a key point about the nature of trucking.

- PART 4: This Part provides a brief critique of previous Canadian research that has attempted to measure the benefits of changing weight and dimension regulations. The accuracy of this work is questionable.

- PART 5: Part 5 describes the current regulations in Canada. The complexity of this topic dictates that it be split in two: Part 5 highlights the subject and a companion report, Vehicle Weight & Dimension Regulations and Canada's Trucking Industry: The Regulations, provides most of the detail and analysis. A key point about the twelve sets of regulations in Canada is that it is difficult to modify them, particularly so as to achieve greater uniformity, unless and until the current regulatory format is understood.

- PARTS 6 to 9: These Parts examine the impact of the different regulations -- first, by considering only the differences that show up in the written form of the regulations; second, by considering the effect of regulations on trucking costs and by considering how these changing, or potentially changing trucking costs translate into costs for shippers; third, by considering how the different regulations in each province influence the provincial truck fleets; and fourth, by considering how weight and dimension regulations and other factors affect individual fleet selection (why does a carrier in one province select a six-axle tractor-semitrailer while carriers in other provinces are using seven-axle A-trains to do the same job?).

- PART 10: In the final Part, some broad observations on the subject are presented.

Although some terms are defined in the text, most definitions are left to a Glossary. Truck combinations are often described using the convenient notation of listing the axles on each vehicle and an "S" to designate a fifth wheel. Hence, the standard five-axle tractor-semitrailer becomes "3-S2" and a typical A-train becomes "3-S2-2."

2. Overview

In June 1986, RTAC and Transport Canada sponsored a symposium on Heavy Vehicle Weights and Dimensions. [8] This was the first time in Canada that so many people from different backgrounds participated in a common examination of weight and dimension regulations. Participants included pavement and bridge engineers, technical experts on vehicle stability, government people responsible for developing and delivering weight and dimension regulations, representatives of the trucking and vehicle manufacturing industries, experts on braking and vehicle safety, people experienced with monitoring trucks and truck activity, and people who looked at the economic issues involved. The program itself had been structured to include discussions -- multi-disciplinary discussions -- of a wide range of issues that must be brought to bear in considering weight and dimension regulations. Nevertheless, there was a problem that some noticed and that was captured in the after-hours conversations: "bridge people talk to bridge people; pavement people talk to pavement people; safety people to safety, economists to economists, . . . "

While some of this was no doubt nothing more than idle banter, there was element of truth to these complaints. On the one hand, the organizers of the conference had had the vision to see that the subject required inputs from many different areas; on the other hand, the experts found it difficult to view the subject as a whole system. The subject matter -- regulating the size, weight, and other characteristics of trucks -- either requires input from or has impacts on:

- PAVEMENTS: In particular, the relationship between axle loads and pavements is critical in terms of the design, life expectancy, and maintenance of pavements and, hence, is a major factor in the cost of roads.

- BRIDGES: Truck size and weight affects bridge design and bridge life. For the regulations, this has most importance for the total load (gross vehicle weight, or "GVW") and the spacing between axles (or axle groups) that carry this load.

- ROAD/HIGHWAY GEOMETRY: The horizontal and vertical alignment of roads, the width of lanes, the design of intersections, and the clearance for underpasses are all factors in determining allowable heights, widths, and lengths of vehicles. Additionally, some of these factors influence aspects of the way vehicles are combined and such factors as weight-to-horsepower requirements (ie, given required traffic characteristics on grades).

- SAFETY: The size of trucks in relationship to other vehicles and in relationship to available vehicle components (engines, suspension systems, brakes, etc.), the manner in which weight and dimension regulations allow trucks to be configured, the effect of the regulations on the centre of gravity of trucks, and other issues all have ramifications for highway safety. Some of these ramifications have received a lot of attention (eg, larger trucks, smaller cars); some are just now being understood as a

result of the RTAC/CCMTA and other research (eg, regulations which favour A-trains over B-trains and which, accordingly, encourage less stable vehicles).

- ROAD/HIGHWAY CAPACITY: While highway capacity is not a major issue where traffic volumes are low, in some cases weight and dimension regulations affect capacity by influencing the number of trucks on the road, the time of day these trucks use the road, and the amount of freight that moves by truck (instead of rail) and, hence, the number of vehicles using the roads.

- TRAFFIC: Many aspects of weight and dimension regulations affect traffic characteristics and/or the way traffic engineers manage traffic (eg, timing cycles for signalized intersections given the different acceleration and stopping characteristics of vastly different-sized vehicles).

- ENFORCEMENT: Different types of regulations have different implications for enforcement effort and, conversely, enforcement effort (or lack of it) has significant consequences for the way the regulations affect trucking.

- TAXATION (of road users): If road-user taxes are to be based on costs, weight and dimension regulations are closely connected to the issue of taxation (ie, they control those aspects of trucks which are most important to road costs). But, even where there is no agreement as to whether on not road taxes ought to be based on costs, there are important revenue implications flowing from weight and dimension regulations (eg, do more small trucks pay more taxes than fewer large trucks?).

- UNIFORMITY: The factor that has become of major importance over the past decade is the uniformity of the regulations among the provinces. To some extent, uniformity between Canadian and U.S. regulations has also been an issue, and may become more of an issue in the future.

- TRUCKING - FLEET SELECTION: The complex inter-relationships between weight and dimension regulations and the vehicles selected by operators is an important, yet poorly understood aspect of the subject. Given various choices within the regulations, or given trade-offs that have to be made, there has been little research into the issue of how and why a carrier selects certain vehicle characteristics (why does one carrier abandon its experiment with wide tires on certain axles because of axle-load regulations? why do some carriers chose certain types of fifth wheels?)

- TRUCKING - COST/PRODUCTIVITY: The relationship between weight and dimension regulations and trucking costs has long been viewed as important aspect of the subject. Its importance was dictated by the need to examine (justify?) expenditure and/or other government decisions on highway improvements.

- SHIPPERS: Usually treated as part of the "truck - cost" issue (ie, changes in truck costs translate directly into changes in shipping costs), the issue of

shippers and weight and dimension regulations is more complex than this. For example, some shippers may not favour regulations that allow double-trailer operations as their facilities are not set up for handling this type of equipment (more loading doors, larger yards, etc.); others may want doubles if the decrease in trucking rates that results is large enough.

- VEHICLE (& component) DESIGN/MANUFACTURE: Different regulations affect many aspects of vehicles and vehicle-component design. For example, given a certain total load, the optimal design of a tank, say in terms of diameter or materials, may or may not be achievable within the dimensional components of the regulations.

- INTERMODAL CONSIDERATION: Weight and dimension regulations, by controlling the productivity of trucks, affect the modal split of freight. This has been a major consideration in U.S. research but has been treated lightly in Canada.

- EXTERNALITIES and OTHER CONSIDERATIONS: Sometimes a range of other factors such as truck noise, fuel usage, air quality and others are considered. These often tend to be sub-topics of one or more of the previous factors.

Historically it was the first three of these factors that had the most influence on weight and dimension regulations: pavements, structures, and geometry were the technical considerations in the regulations that emerged prior to and after the second world war in both the United States and Canada. Throughout the 1950s, 1960s, and 1970s, more factors began to be considered. In the 1960s, trucking efficiency was first considered. Safety became the big issue over the last decade or so. Starting in the early 1970s, the issue of uniformity grew to be a major factor in the determination of desirable regulations.

This expansion of the factors considered in examining weight and dimension regulations is desireable as it recognizes the complexity of the subject: regulating the size of trucks is not simply an issue to be decided on the basis of pavement, bridge, and roadway geometry considerations (with perhaps a little truck costing thrown in). Yet even with the growing recognition of the multi-faceted nature of the problem, there is something missing. No one has yet put all the pieces together into a comprehensive system view of trucking and roads.

To expand on this, while it is now generally appreciated that the above list of fifteen or so factors constitute important considerations in the design of weight and dimension regulations, there seems to be little appreciation of the fact that the two-way relationship between one of these factors and the regulations affects most or all of the other factors. For example: setting axle-load regulations to minimize pavement deflection may have an impact on the way loads affect bridges; it may also affect road geometry (ie, the placing of axles on the vehicle affects such things as turning circles); it may affect road safety through the effect of axle spacing on stability; it may affect traffic and/or capacity if it causes inter-modal freight shifts; it may affect enforcement in terms of the ease and/or difficulty of enforcing different types of axle-load regulations; it may affect road-user taxes if these are based on

road costs; it certainly can affect uniformity if other jurisdictions opt for a different way of setting axle-load limits; it has a large impact on the way carriers select their fleets and on the cost/rate characteristics of these trucking operations; and it may affect the way a manufacturer builds vehicles (eg, the regulations may make one type of axle optimal but available suspension systems may dictate the use of other axle arrangements). This is the "multiple-impact" appreciation of one regulatory decisions (axle-load regulations) on the whole range of fifteen (and possible more) factors.

There is another perspective. To continue with the previous example: what if the determination of one factor (say the way the axle-load regulations affects stability/safety) affects other factors (say a change in truck safety affects insurance rates which affects trucking costs which affects shipping rates which affects modal shifts which affects . . . .)? The is the full "system-impact" appreciation of the subject.

The research reported here does not provide the full system-view of weight and dimension regulations. While this holistic approach has guided the research, the scope of the work was limited to about four of the above factors -- uniformity, trucking fleets and fleet selection, trucking costs/productivity, and shippers (ie, trucking rates) -- with some spill-over into some of the other factors (eg, enforcement).

3. Trucking and Roads

Two aspects of trucking and roads demonstrate that weight and dimension regulations have a large potential impact on the economy and that much of the current research effort and/or attempt at changing these regulations suffers from a myopic view of the system.

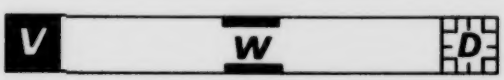
Canada has invested a considerable amount in roads. Currently, there are about 279 thousand kilometres of federal and provincial roads in Canada, and, although the data is weak, the length of municipal or local-government roads is probably double this. [9] This network of just under one million kilometres represents a substantial investment -- one attempt to measure it suggested a book value in 1979 of $36 billion and a replacement cost (in 1979 dollars) of $87 billion. [10] Annual expenditures on these roads amount to $5 to $6 billion. [11]

Statistics on trucking activity in Canada are incomplete. Nevertheless, it is possible to estimate that in 1984 the total operating expenses of all trucking activity in Canada amounted to $22 billion. By comparison, total rail operating expenses in 1984 were $7 billion. [12]

There are two points to observe. First, it is clear that there is a potentially high cost element to weight and dimension regulations. That is, looking at it from the perspective of using roads, it is likely that changes in or even "fine-tuning" the regulations has a potential of changing the annual maintenance and/or replacement cost of a very expensive asset. Suppose, for example, that the regulations are set such that axles do a tiny bit more damage to pavements than they would if the regulations were set slightly differently (ie, altering spread requirements, regulating or not regulating suspension systems), or suppose the regulations are written in such a way so that enforcement is not as effective as it might be. A "tiny bit" multiplied across the whole multi-billion dollar system amounts to many millions of dollars.

From the perspective of the trucks using this asset, weight and dimension regulations have a lot to do with the efficiency of the $22 billion. Although no one knows the true amount (and it may be futile to guess), it is conceivable that weight and dimension regulations control a very substantial portion of this $22 billion: that is, larger/smaller or different trucks may provide the same amount of freight service as is now provided for several billion dollars more or less than this $22 billion.

The second point is that there are two ways of looking at this trucking activity on public roads. The first is that, at $87 billion (and in current dollars probably well over $100 billion), the role of government is to protect its investment by ensuring it lasts as long as possible (or that it minimizes its annual maintenance costs). The second more enlightened view is that, with $87 billion invested, the role of government is to ensure the most efficient use of this asset. This second attitude would lead to decisions that viewed the determination of weight and dimension regulations as a balancing act between the rate at which an asset is used on the one hand and the efficiency of an activity occurring over it on the other. (This does not deny



that there are other goals such as safety in the determination of optimal weight and dimension regulations.)

A few more facts about roads and trucking are necessary to complete this setting of the subject matter.

The latest figures from Statistics Canada suggest that at least 45 percent of all for-hire truckers and 72 percent of all private truckers are solely intraprovincial operators. Of the ten largest origin-destination pairs in the commodity flow matrix, all but one as measured by tonnes hauled are intraprovincial for for-hire carriers; and all ten are intraprovincial for private carriers. Even if tonne-kilometres are used as the measure, the top five origin-destination pairs for for-hire truckers and the top ten for private truckers are intraprovincial. Further, 21.4 percent of all for-hire shipments and 48.4 percent of all private truck trips are less than 100 kilometres. [13]

These figures under-estimate the local nature of trucking in Canada as the carriers covered in the surveys are the larger ones who provide most of the interprovincial trucking services. Ignoring this possible under-estimation, the reason for drawing attention to these figures is to emphasize that a great deal of trucking is a **local activity**. Furthermore, as the previous figures on the road network suggest, probably two-thirds of all roads in Canada are municipal and/or local. Some of these roads are probably little more than dirt trails with little traffic. Without entering into the debate as to whether or not the roughly 660 thousand kilometres of local-government roads are more or less important than the 279 thousand kilometres of federal/provincial roads, it is simply noted that local roads are "important" (however defined). So, considering both truck activity and roads, the impact of weight and dimension regulations is often a very local matter.

The curious thing about most of the research into weight and dimension regulations and the regulatory changes being contemplated is that the focus is on interprovincial trucking. For example, the RTAC/CCMTA study did not look at configurations such as the truck-plus-trailer ("it is not important in interprovincial transport" was the reason given). Yet truck-plus-trailer configurations account for more trucks on the road than all A-, B-, and C-trains combined in many instances. As another example, the level of input from municipal governments in the current effort to modify regulations is virtually zero -- this in spite of the fact that two-thirds of the roads fall under their jurisdiction. The only regulatory changes worth talking about these days are those that introduce a greater degree of uniformity among the provinces -- to the benefit of interprovincial truckers using the primary (basically provincial) highway system.

The point is that research into and regulatory change concerning interprovincial trucking is important; if, however, these concerns become the only issue, then something has been missed in the understanding of trucking and roads in Canada.

4. Previous Research

A growing body of research has developed since about 1970 that attempts to evaluate the impact, particularly the economic impact, of changing and/or different weight and dimension regulations. Almost all of this was government-funded, in response to some requirement to produce an estimate of benefits flowing from an increase in government expenditures on highways. As with most research, and certainly as with all research dealing with roads and trucking in Canada, there have been data problems. Indeed, much of the research effort has gone into surveys. While the lack of data has hindered the research work, some major conceptual deficiencies have also been evident. [14]

First, there has been an over-simplification of the consequences of changing the regulations. Generally, the research is structured as a cost-benefit analysis with costs being the increase in road costs (pavements, bridges, etc.) and benefits being the reduction in freight costs occurring as a result of the use of larger trucks. The efficiency of the trucking/road system is more complex than this. The "benefit side" involves more than just the ratio of truck costs to trucking output. Even if it is accepted that changes in truck operating costs are a good first approximation, there are problems in the way this measure is used. Often, the assumption is that the reduction in cost is the decrease in the potential costs per unit of shipment weight; there have been few efforts at developing empirical measures for the utilization rate of large trucks or the density characteristics of freight. Implicitly, it is assumed that the relevant costs are only linehaul trucking costs with no consideration given to either how linehaul operations might change (eg, a change in the proportion of empty miles or even inter-city versus local miles) or how other aspects of trucking might change (terminal operations, switching-yards, pickup and delivery). With respect to for-hire operations, there has been little research as to the degree to which cost reductions are passed through to the shipper.

A second deficiency has been the failure to analyze fleet characteristics -- only part of the blame for this can be attributed to the paucity of data. The research has typically started with the development of scenarios for the characteristics of the fleet under various regulatory alternatives. But to date, it has been difficult to properly characterize current fleets -- let alone fleets under some other scenario. Specifically, it is difficult to find research which documents the number of large trucks by registered weight, by body style, by actual operating weights, by configuration characteristics, by annual usage (kilometres, tonne-kilometres, etc.), by commodity specialization, by class (for-hire, private, farm, etc.).

The understanding of how fleets change over time, both as a result of changes in weight and dimension regulations and, of equal importance, as a result of other forces, is limited. This is critical as most research is forced to make a simplistic assumption such as "the regulatory change will work its way through the fleet in five years."

A third major deficiency has been the failure to conduct cross-sectional or comparative research. Logically one might expect an analyst charged with estimating the impact of a change in regulations to begin by looking at other jurisdictions to see how fleets differed under different regulatory regimes. This has not been done to any great extent in Canada. Much of the research has been done in ignorance of research efforts elsewhere; and little research has been done where the main purpose was to compare the fleets of different jurisdictions.

A fourth deficiency has been the poor forecasting. For example, in one study, data from a 1973 road-side survey was used to make forecasts for truck traffic five years into the future. Another survey was conducted five years later at almost the identical weigh scales as in the first survey. The following compares the forecast with the actual 1978 data (in millions of ton-miles):

	Forecast (1978)	Actual (1978)
All traffic	44.6	113.3
Intraprovincial traffic	18.4	80.0

The fact that the study went on to multiply its results by an estimated 2.56 to account for trucks missed in the survey, and to further multiply the results by an estimated 51 to account for the weeks not included, and to further multiply the results by estimated costs for a vaguely defined mix of truck types five years in the future only compounded the possible errors. It is impossible to have much confidence in these estimates of the potential "benefits" of allowing large trucks.

A fifth deficiency has been the over-simplifications evident in the definitions of scenarios: to date, most research has only attempted to deal with simple regulatory changes -- an increase in allowable GVW's, an increase in allowable axle loads. Weight and dimension regulations and changes in these regulations over the past decades (and presumably into the future) are more complex than this. With the regulatory changes that have been made in Canada, most of the research effort (respecting the "benefits") has tended to focus on weight issues only; many issues necessary to make these increases effective have been ignored: cube, centre of gravity, load distribution, suspension systems, etc.

The last major deficiency has been the "applied" nature of the research. The research has suffered because of the necessity of producing a hard quantitative estimate of the benefits of changing regulations -- this has been the mandated purpose of the research given that all of it has been sponsored by governments about to spend money on improving the highways. This results in studies where most of the effort goes into making (or justifying) assumptions to develop procedures capable of producing a number, rather than studies where most of the effort goes into an attempt at understanding what is happening.

5. The Regulations

5.1 Introduction

As roads and most regulations concerning roads are under provincial jurisdiction, there has evolved a series of twelve different sets of weight and dimension regulations. The differences are not just in the allowable truck dimensions and weights; they also include important differences in definitions and/or formats. It is true that some of these differences are not critical for day-to-day truck activity; however, they become important when someone attempts to draw up a simple chart showing the different weight and dimension regulations across the country. If the chart is to be accurate, the footnotes and qualifications take up more space than the chart itself.

For this reason, a separate report has been prepared to consider the nature of weight and dimension regulations in detail. Certain conventions have had to be adopted: for example, each province's regulations are considered to consist of 13 elements (vehicle height, vehicle width, axle loads, etc.) and within each of these elements a number of topics are considered (current standard regulations, conditions attached to the regulations, exceptions, etc.). These conventions are useful; in fact they may be essential if comparisons between regulations are to be made. But these constructs are just conventions: the regulations of individual provinces are quite different than the format used in Vehicle Weight and Dimension Regulations in Canada.

The next section contains an overview of the standard regulations in a simplified format (ignoring most of the qualifications). "Standard" regulations are those governing most trucks operating on primary highways in the summer. Section 5.3 summarizes the major differences between the provinces; Section 5.4 outlines the major changes since 1970; Section 5.5 considers some aspects of the "non-standard" regulations; and the last Section briefly considers a topic that has not yet been well researched -- enforcement.

5.2 Standard Weight and Dimension Regulations

Regulations control the following elements of a truck:

- **height** of the vehicle (and load)
- **width** of the vehicle (and load)
- **length** of the vehicle (and load): There are four sub-elements: tractors and/or straight trucks, full trailers, semitrailers, and combinations.
- **tire loads**

- **axle loads**: These have to be sub-categorized into a number of different axle types (single-front steering, other-front steering, single-non-front steering, tandem, triple, etc.)

- **vehicle loads** (or allowed GVWs): These have to be understood in terms of a series of associated load-spacing rules.

On the basis of these elements, it is possible to compare the regulations as shown in Table 1. As discussed, the information contained in this Table provides an incomplete view of weight and dimension regulations. The footnotes that could be written qualifying or expanding on the information shown would fill many pages; further, the detail provided would still not enable anyone to identify a truck as "legal" or not.

It is difficult to describe to anyone who has not attempted to read the twelve sets of weight and dimension regulations just why the regulations are so complex -- and why Table 1 is an over-simplification. Some of the reasons for this complexity are:

- Different definitions: For example, "axle group", "axle", or "tandem" mean different things in different provinces. The way some provinces define a "tractor" may affect, for example, the use of dromes (a "drome" is a load-carrying device mounted on a tractor; some provinces have defined "tractors" as vehicles used for towing other vehicles and some provinces have defined tractors in terms of their non-load carrying characteristics).

- Different terminology: Some provinces use "tri-axle" and "triple axle" interchangeably; some use one or the other, but not both; some use neither term; and some have two meanings for the two terms.

- Different methods used to "spread" weight: The provinces use a variety of methods to ensure the vehicle loads are spread over the longitudinal length of vehicles. Some of these methods are referred to as a "bridge formula" (these regulations allow a great many configuration types); other methods are simpler in that they impose a minimum axle spacing requirement and then have a system of load penalties for spacings of less than these minimums; and still other methods are even simpler in that they recognize only a certain number of fixed axle type/spacing arrangements.

- A maze of exceptions, exemptions, and special cases: For example, some commodities, some truck types, some roads, some areas within a province, some seasons, and some combinations of some of these factors in some circumstances are exempted from the "standard" regulations. (These are dealt with in part in Section 5.5)

- "Interpretational" components to the regulations: There are parts of the regulations that are difficult to understand by considering only the

"written" component. For example, in two provinces the written regulations appear to say that only A-trains are allowed a total length of 23 metres; actual practices are to allow both A- and B-trains this length.

	ALLOWABLE DIMENSIONS (metres)								
	height	width	length						
						combinations			
			truck or tractor	full trailer	semi trailer	tractor -semi	truck + trailer	A-train	B-train
Nfld	4.15	2.6	12.5	14.65	14.65	20.0	20.0	*	21.0
NS	4.15	2.6	12.5	14.65	14.65	21.0	21.0	*	21.0
PEI	4.5	2.6	12.2	none	none	20.0	*	*	*
NB	4.12	2.6	12.5	14.65	14.65	21.0	21.0	*	21.0
Que	4.15	2.6	12.5	14.65	15.5	23.0	23.0	23.0	23.0
Ont	4.15	2.6	12.5	12.5	14.65	23.0	23.0	23.0	23.0
Man	4.15	2.6	12.5	12.5	none	20.0	21.5	23.0	23.0
Sask	4.15	2.6	12.5	12.5	14.6	20.0	23.0	23.0	23.0
Alta	4.15	2.6	12.5	12.5	none	20.0	23.0	23.0	23.0
BC	4.15	2.6	12.5	12.5	14.65	20.0	23.0	23.0	23.0
Yukon	4.2	2.6	12.5	13.5	13.5	22.5	22.0	*	*
NWT	4.2	3.05	12.5	12.5	none	21.5	21.5	24.4	24.4

	ALLOWABLE LOADS ('000 kg, except tire loads) (3)								
	tires kg/mm	single axle		tandem axle	triple and/or triaxle	maximum gvw			
		front steer	non-front			truck	truck + trailer	tractor semi	train (2)
Nfld	10	9,000	9,000	18,000	27,000	34,000	52,500	48,500	52,500
PEI	10.7	9,000	9,000	18,000	27,000	26,082	*	53,296	*
NS	rating	9,000	9,000	18,000	27,000	34,000	50,000	48,500	50,000
NB	10.7	9,000	9,000	18,000	27,000	34,000	56,500	48,500	56,500
Que	rating	8,500	10,000	20,000	30,000	37,500	57,500	57,500	57,500
Ont	11	9,000	10,000	19,100	30,000	47,500	63,500	63,500	63,500
Man	9	8,190	9,100	16,000	16,000	32,000	56,190	40,190	56,500
Sask	9	5,500	9,100	16,000	16,000	27,000	53,500	37,500	53,500
Alta	9	7,300	9,100	16,800	16,800	30,400	53,500	40,900	53,500
BC	11	9,100	9,100	17,000	26,100	34,000	60,100	52,200	63,500
Yukon	11	9,000	10,000	19,100	28,600	47,500	63,500	63,500	*
NWT	8	6,500	8,128	16,256	16,256	29,256	54,500	39,012	54,500

Table 1 Weight and Dimension Regulations (1)

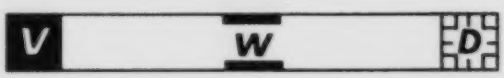
NOTES

1) *The information is subject to qualifications and/or conditions. These regulations apply to most trucks, on primary highways, in summer driving conditions. Various area, vehicle, commodity or hauling-type, seasonal, highway, and other exceptions apply (but are not shown).*

2) *In some cases, lower GVWs apply depending on whether the combination is an A- or B-train.*

3) *Tolerances have not been included. There are a number of axle-spread and axle-spacing requirements that must be met.*

* *Special permits required.*



There are not the only differences among the provinces, but they are the differences or factors that are particularly important in understanding why the regulations are difficult to understand (even for the provincial officials who develop or enforce them).

5.3 MAJOR DIFFERENCES

The major differences in weight and dimension regulations as of the winter of 1986/87, without worrying about some of the minor points (such as definitions), are as follows:

- HEIGHT, WIDTH, SINGLE-VEHICLE LENGTHS: None of the (minor) differences that exist are of great importance.

- COMBINATION LENGTHS: A major difference in combination lengths currently exists between Atlantic Canada and the rest of the country: 20 to 21 metres for all combinations in Atlantic Canada versus 23 metres for doubles and in some cases tractor-semitrailers in the rest of the country. A second major difference is the practice in Central Canada of allowing tractor-semitrailers a total length of 23 metres whereas Western Canada restricts these combinations to 20 metres. A third difference concerns truck-plus-trailer configurations: five provinces allow these an overall length of 23 metres (sometimes with conditions), the remaining provinces allow 20 to 22 metres.

- KINGPIN-TO-REAR LIMITS: When the 23 metre length limit was established, the distance between the kingpin and the rear of the vehicle was limited to 16.75 metres (at the time, 55 feet). (See the companion report on regulations for the history and the rationale.) Increasingly this condition has been relaxed so that the 16.75 kingpin limit may be exceeded in some circumstances. The importance of this is that it is difficult to operate double 28-foot pups within this limit.* Currently Quebec, Ontario, and Saskatchewan allow the 16.75 metre limit to be exceeded, and Alberta and British Columbia are in the process of modifying their 16.75 metre limit. Barring Atlantic Canada, where there are other complicating factors, this leaves Manitoba as the only jurisdiction making the use of double 28-foot pups difficult on cross-Canada operations.

- TIRE LOADS: There is a great deal of diversity in tire-load regulations: some provinces allow so many kilograms per millimetre of nominal tire width; some rely on manufacturers' ratings; some rely on both a load-per-width and a rating; some have different allowed loads for different tires; some limit total tire size and/width; etc. However, it is not clear that these differences are of great significance to most day-to-day truck operations -- particularly interprovincial truck operations -- as any truck equipped with standard 10 or 11 inch tires will ordinarily be over-loaded on its allowable axle weight before exceeding the allowable limit on tire loads.

---

* *Double 28' pups are becoming a North American standard configuration (given various regulatory changes in the U.S. in 1982).*

- ALLOWABLE SINGLE-FRONT-AXLE LOADS: Given all of the conditions attached to the regulations, allowable front-axle loads vary from 3,200 to 10,000 kg. However, for typical vehicle types the variation in permitted loads is only 5,500 to 9,100 kg. The significance of this lack of uniformity is not clear, as for many trucking situations the front axle load is not critical given vehicle design and loading practices. Probably the place where these differences become most noticeable is at the Ontario-Manitoba border: in Eastern Canada, high front axle loads are allowed and are fairly common for some configurations; west of this point, 5,500 kg is the standard front-axle load allowed for many configurations (until the Alberta-British Columbia border is reached).

- SINGLE-AXLE LOADS: The difference between 9,000 kg (Atlantic Canada) and 10,000 kg (Central Canada) is probably not of great significance in considering inter-jurisdictional differences in Canada. (The 8,128 kg limit in the Northwest Territories might be a significant difference, but it affects few trucks.)

- ALLOWABLE TANDEM-AXLE LOADS: Under normal circumstances these vary from 16,000 to 20,000 kg; definitions and spread requirements also vary. Currently the country divides up into three regions: the "high-load" provinces of Quebec, Ontario, and the Yukon allowing 19,000 to 20,000 kg; the "mid-range" provinces in Atlantic Canada and British Columbia allowing 17,000 kg (or 18,000 kg for non-powered vehicles in Atlantic Canada); and the "low-load" provinces in the Prairies where 16,000 kg is the limit with no axle-spread provisions in the regulations (Alberta does allow somewhat higher loads for very wide-spread tandems).

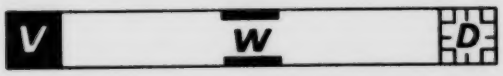
- TRIPLE AND/OR TRI-AXLES (including the use of liftable "belly" axles): The use or non-use of triple and/or tri-axles is probably the most significant difference in the current regulations (although this issue of triple and/or tri-axles has to be considered with allowable GVWs to be fully understood). There are four regions in Canada: Quebec, Ontario, and the Yukon which allow many variations on this type of axle at high loads (up to 30,000 kg); Atlantic Canada which allows these axles but only recognizes a few specific types (ie, a limited number of axle-spacing/axle-spread possibilities) with fairly high loads (up to 27,000 kg); British Columbia which allows tri-axles to be used at loads of up to 26,100 kg, but imposes some conditions (steerable, spacing); and the rest of the country which does not recognize triple and/or tri-axles ("not recognize" is an over-simplification).

- MULTIPLE AXLE COMBINATIONS: Aside from tandem-axle, triple-axle, and tri-axle groups, there are a number of other possible axle groups on a semitrailer (eg, four single axles, two tandem axles, a triple plus a single, etc.). Only two jurisdictions (Ontario and the Yukon) allow these types of axle combinations under standard weight and dimension regulations. Quebec has just recently allowed "quad-axles" under special permits.

- GROSS VEHICLE WEIGHTS: The major differences in allowable GVWs are: differences in the upper limit (50 to 63.5 tonnes); differences in the types of combinations allowed high GVWs (in some provinces, only doubles can register with high GVWs); differences in the road systems where standard regulations apply (ie, in New Brunswick and Manitoba the upper GVW limits apply to major highways only; in Alberta, the GVW limit applies to all highways); and, differences in the method of calculating allowable GVWs. This last difference is complex enough to require 17 pages of text in Vehicle Weight and Dimension Regulations in Canada. The various methods range from the complex with many possibilities and, hence, a great variety of vehicle types (Ontario, the Yukon, and to some extent Quebec), to the simple with few possibilities and a relatively rigid designations of what is or is not allowed (Atlantic Canada). Other provinces fall somewhere in between these two points.

- COMBINATION-TYPES: There are a variety of regulations and/or policies that favour or encourage truck-plus-trailer, tractor-semitrailers, or A-, B-, or C-trains. For example, some regulations such as those in Manitoba encourage the use of A-trains; other regulations such as those in Ontario favour B-trains slightly under some circumstances. The significance of these differences, the slight encouragement or discouragement of one type, is hard to gauge. There are, however, three major differences. First, primarily because of the GVW and axle-spacing requirements on the Prairies, the use of double-trailer combinations has become the norm for many trucking situations. Second, and for exactly the opposite reasons, doubles are far less common in Central Canada where both higher loads (up to 63,500 kg in Ontario) and higher cubes (roughly 37% higher than the cube available on a standard 48' semitrailer) are possible in tractor-semitrailer configurations. Third, in Atlantic Canada A-trains (and, in one case, B-trains) are not permitted under the standard regulations.

- SPECIAL PERMITTING: Although this Section deals only with the standard regulations, it must at least be pointed out that special permitting practices vary significantly from province to province and that these practices are important enough to require some qualifications to this list of significant differences. For example, A-trains do operate into New Brunswick on occasion under special permit; Quebec does also allow more than three axles on a semitrailer under special permit; the Prairie provinces all do special permit long-combinations vehicles (ie, doubles and triples exceeding the 23 metre length limit); configurations such as automobile carriers in one province cannot be compared to automobile carriers in another province in terms of understanding differences in standard regulations as in the one case they all operate under special permits; some trucks, such as those used in construction, in one province may look similar to those in another, but that is only because one of the provinces special permits these vehicles and **not** because the standard regulations are similar (so, for example, it is possible to see triple axles on the Prairie provinces even though it has just been noted that the Prairies do "not recognize" these axle groups).



5.4 CHANGES THROUGH TIME

The current regulations, the current research activity, and the current relationship between the regulations and trucking cannot be understood without reference to the changes that have occurred since about 1970/71. Ontario introduced its Bridge Formula in 1971; this is probably the best point to consider the start of modern regulations.

- HEIGHT: In 1970, most provinces allowed 13'6" (4.1 m); other than the switch to metric, this is still the standard today.

- WIDTH: In 1970, 102" (2.59 m) was the standard in all provinces, with possibly a few minor exceptions on some roads. Currently, all jurisdictions except the Northwest Territories have adopted the metric equivalent of 2.6 metres.

- LENGTH: In 1970 most provinces only limited the length of a "vehicle" irrespective of whether it was a power unit, a trailer, or a semitrailer. Also, all provinces limited the length of vehicle combinations. Each of these limits is dealt with in the following notes.

- LENGTH - SINGLE POWER UNITS: In 1970, eight provinces limited the length of a single vehicle to 35 ft (10.67 m), although in one case the restriction applied only to the wheelbase. Three other provinces allowed 40 ft (12.19 m). Currently, ten provinces allow 12.5 m and two allow 12.2 m, with the result that the length of a truck or tractor has been increased by anywhere from 0.31 m to 1.83 m (2.5% to 17.2%).

- LENGTH - TRAILERS AND SEMITRAILERS: Information is incomplete; it appears that the general change has been from 35 or 40 ft to the current 14.65 m (or no limit): in many cases, the allowable length for (semi)trailers has increased by more than one-third.

- LENGTH - COMBINATIONS: In 1970, nine provinces allowed 65 ft (19.81 m); although in some cases this was on designated highways only. The exceptions were Prince Edward Island (80 ft or 24.38 m), New Brunswick (60 ft or 18.29 m), and the Northwest Territories (not known). Currently, six provinces have adopted the 23 metre standard originally introduced in the Prairie provinces. With one exception (Prince Edward Island), the increase in allowable lengths for combinations has been in the order of 1.19 m to 3.19 m (6.0% to 16.1%) with most provinces at the high end of this range. Prior to 1970, only one province allowed even longer combinations on a special permit basis (Alberta); as of 1987, four provinces (the Prairies and Quebec) allow extra-long combinations (triples, Rocky Mountain doubles, and turnpike doubles) on a special permit basis for a relatively large number of vehicles.

- SINGLE (NON-FRONT) AXLE LOADS: In 1970, 18,000 pounds (8,165 kg) was the standard single-axle load. (This load, and others reported here,

exclude tolerances.) Today, all provinces except the Northwest Territories have increased this to the 9,000 - 10,000 kg range.

- TANDEM-AXLE LOADS: In 1970, ten provinces allowed 32,000 pounds (14,515 kg) on tandem axles, and one province allowed 30,000 pounds (13,608 kg). (Information on the twelfth province is not known.) Currently, allowable loads are 16,000 kg (Prairies) to a high of 20,000 kg (Quebec). Increases have ranged anywhere from 1,485 kg to 6,392 kg.

- TRIPLE AND TRI-AXLE LOADS: In 1970, only one province (Ontario) recognized triple axles by allowing a loading higher than a tandem axle. Today, all provinces except the Prairies and the Northwest Territories recognize triple and/or tri-axles.

- GROSS VEHICLE WEIGHTS: Owing to the increase in allowable loads on single and tandem axles, the recognition of triple or tri-axles, and a general increase in allowable GVWs, the most dramatic change in weight and dimension regulations has been the increase in allowable total loads. In 1970, most provinces imposed an upper limit of 74,000 pounds (33,566 kg). In other provinces, the limit was close to 74,000 pounds in all cases except Ontario which allowed 116,000 pounds (52,617 kg). Today, GVW limits are anywhere from 10,883 kg (Ontario) to as much as 30,052 kg (Yukon) higher.

To put these changes in perspective, the following shows the increase in kilograms between 1970 and 1987 in the allowable loads for single axles (non-front), tandem axles, and gross vehicle weights. (Information on the Northwest Territories is not available.) The figures in parentheses show the percentage change.

	Single	Tandem	GVW
Nfld.	+ 835.3 (10.2)	+ 3,485.0 (24.0)	+ 22,934.2 (68.3)
P.E.I.	+ 935.3 (11.5)	+ 3,585.0 (24.7)	+ 19,034.2 (59.4)
N.S.	+ 835.3 (10.2)	+ 2,485.0 (17.1)	+ 16,434.2 (49.0)
N.B.	+ 835.3 (10.2)	+ 3,485.0 (24.0)	+ 22,934.2 (68.3)
Que.	+ 1,835.3 (22.5)	+ 6,392.2 (47.0)	+ 23,934.2 (71.3)
Ont.	+ 1,835.3 (22.5)	+ 4,585.0 (31.6)	+ 10,883.3 (20.7)
Man.	+ 935.3 (11.5)	+ 1,485.0 (10.2)	+ 22,934.2 (68.3)
Sask.	+ 935.3 (11.5)	+ 1,485.0 (10.2)	+ 19,934.2 (59.4)
Alta.	+ 935.3 (11.5)	+ 1,485.0 (10.2)	+ 20,841.3 (63.8)
B.C.	+ 935.3 (11.5)	+ 2,485.0 (17.1)	+ 29,027.0 (84.2)
Yukon	+ 1,835.3 (22.5)	+ 4,585.0 (31.6)	+ 30,051.7 (90.4)

5.5 NON-STANDARD REGULATIONS

A considerable amount of trucking occurs outside of the standard regulations. There are four main areas: exceptions (eg, some vehicles or some commodi-

ties are exempted from the standard regulations); time of year regulations (summer, winter, spring); class of road regulations (primary, secondary); and special permitting regulations.

Most of the exceptions do not require mention here (see the companion report on regulations). For example, many provinces exempt snow ploughs or farm vehicles from some aspect of the regulations; Ontario allows loads of raw forest products to exceed its standard width limits by a small margin. The only major exception to note, because of the amount of trucking involved, is Quebec's treatment of certain straight trucks (eg, dump trucks or garbage trucks). These are exempt from some of the axle-load limits with the result that they can have very high front axle loads (10,000 kg) and very high tandem loads (20,000 kg) with no axle-spread requirements.

There are two time-of-year variations: spring load reductions and winter load premiums. The most common is the reduction of allowable axle loads in the spring (owing to the condition of the pavements at this time of the year). In most provinces, these spring axle-load reductions ("spring bans") apply only to secondary roads. In two of the Prairie provinces, tire loads on secondary roads are reduced in the spring rather than axle loads. The other relatively common time-of-year deviation from the standard regulations (six provinces) is an increase in allowable loads in the winter when the ground is frozen. The actual application of these winter increases varies considerably: in Ontario, it applies to both axle loads and GVW but is limited to trucks hauling raw forest products; in British Columbia it applies only to logging trucks; Saskatchewan has the most rational and consistent system of increasing tire, axle, and GVW limits in the winter.

The road class deviations from the standard weight and dimension regulations are many and varied; in some cases they are intimately connected to other features of the regulations (such as time-or-year changes). Over-simplifying, there are probably only four provinces with extensive secondary road systems where the axle load and GVW limits shown in Table 1 do not apply: Nova Scotia, New Brunswick, Manitoba, and Saskatchewan. Details on the regulations governing these secondary roads are contained in Vehicle Weight and Dimension Regulations in Canada.

Finally, to put the topic of special permitting into perspective, some aspects of the research work that went into this study have to be described. At the time the terms of reference were drawn up, it was believed that all the effort had to go into understanding the standard weight and dimension regulations and that special permitting was something to keep in the back of one's mind when thinking of those few "exotic" trucks (triples on Highway #2 between Edmonton and Calgary, or overloaded and multi-axle trucks carrying enormous machinery). Now that the research is complete, this perspective has changed. Special permitting is probably such a complex subject covering so much trucking that attention has to be drawn to the fact that little is known about it: in the recent rush to undertake research germane to weight and dimension regulations, special permitting has been neglected.

Without, therefore, having conducted any research into the topic, only a few aspects can be described. First, all provinces make allowances for special permits

under their statutes and/or regulations. While it is known that some provinces have written policy guidelines on how and where special permits are to be issued, these documents have not be examined and/or compared. In terms of the number of trucks operating under special permits, there are no good data sources, but a few "facts" have been gleaned from some of the provinces.

In Alberta, in 1984, something in the neighborhood of 80,000 single-trip permits were issued; this does not include the special permits under which Alberta's triples or long doubles operate. Ontario issues about 30,000 to 40,000 special permits a year, but these numbers are not directly comparable to the ones from Alberta as they include "single-trip", "project", and "annual" special permits (ie, there is no way of converting to the number of truck trips). As an example of special permitting practices in Ontario, all automobile carriers operate under annual special permits (for over-height vehicles). New Brunswick issued 6,670 special permits in 1984 under a number of categories; again, the number cannot be directly compared to the figures from either Ontario or Alberta. One of these categories in New Brunswick is "oversize, one year" under which 2,607 permits were issued. In other words, there are 2,607 trucks operating on a year-round basis that exceed some aspect of the dimensional limits shown in Table 1. (It is speculated that most of these trucks are involved in the forest industry.)

While this data from three provinces is hardly exhaustive or conclusive, it does suggest that special permitting is of considerable importance in understanding trucking.

5.6 ENFORCEMENT CONSIDERATIONS

The subject of enforcement, or the consideration of how the regulations are written versus how the regulations are actually applied, was not a major topic during the course of this research. However, it has become increasingly apparent that this topic (along with special permitting) is critical.

For here, only three aspects about enforcement can be noted. First, other than asking the provinces for the number of violations, it appears that data sources for comparative research is scarce. Second, in comparing the regulations of one province with those of another, it has become clear that some regulations are easier to enforce than others. This aspect of regulations -- their enforceability -- has often been over-looked in the past when regulations were changed. Third, from the case studies undertaken with the help of forty carriers and trailer manufacturers, it is evident that enforcement issues are a factor in fleet selection. More on this in Part 9.

6. Regulations and Trucking Part 1: Paper Differences

6.1 INTRODUCTION

In Part 5, an overview of the major differences in weight and dimension regulations was given. Here, the focus is on how these differences translate into vehicles. For the most part, though, these vehicles are hypothetical or "on paper" -- the more detailed consideration of how individual operators select trucks is left for Part 9.

6.2 THE STANDARD TRACTOR-SEMITRAILER

To start, Table 2 shows the most common configuration, the five-axle tractor semitrailer ("3-S2"), with specifications making it legal in all twelve jurisdictions. The legend used is as follows:

o	•	a single-tire axle (ie, 2 tires in total)
0	•	a dual-tire axle (ie, 4 tires in total)
0--0	•	a tandem axle
0--0--0	•	a triple axle
1.2	•	axle spread, in metres
| - 10 - |	•	axle spacings, in metres
load	•	axle load, in tonnes

specifications

wb	•	tractor (truck) wheelbase
os	•	fifth wheel offset, in metres
kp	•	kingpin setback, in metres
fo	•	front overhang, in metres
bo	•	back overhang, in metres
tw - fr	•	tire width - front, in millimetres (inches)
tw	•	tire width for non-front tires, in millimetres (inches)
length	•	trailer length, in metres (feet)
drawbar	•	distance between the back of one (semi)trailer (or truck) and the front of another trailer, in metres
tare	•	tare weight, in tonnes. Typical tare weights are assumed: actual tare weights vary considerably.

measurements

length	•	overall vehicle (or combination) length, in metres
GVW	•	gross vehicle (or combination) weight, in tonnes
payload	•	payload, in tonnes
cube	•	cubic capacity (assuming vans with inner dimensions of 2.54 metres in width, 2.69 metres in height, and a length of 10 cm less than the total trailer length)

Given the regulations of all twelve jurisdictions, there are three constraints on the tractor-semitrailer shown in Table 2 (other than the width and height limits): first, the tire load regulations of the Northwest Territories limit the front axle to 4,470 kg (given 11" tires); second, the semitrailer length of 13.72 metres (45') is

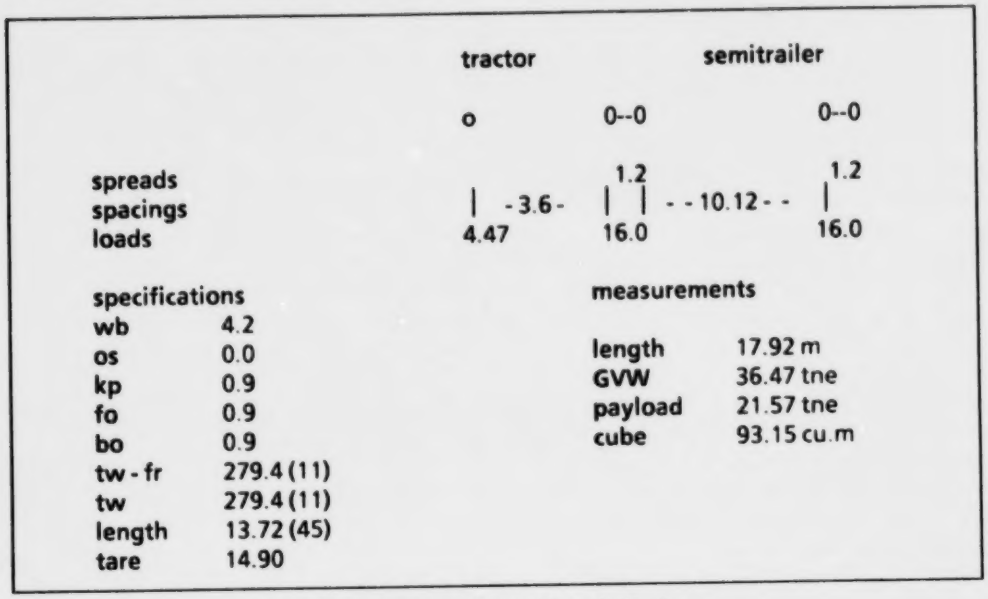


Table 2 Standard 3-S2, All Jurisdictions

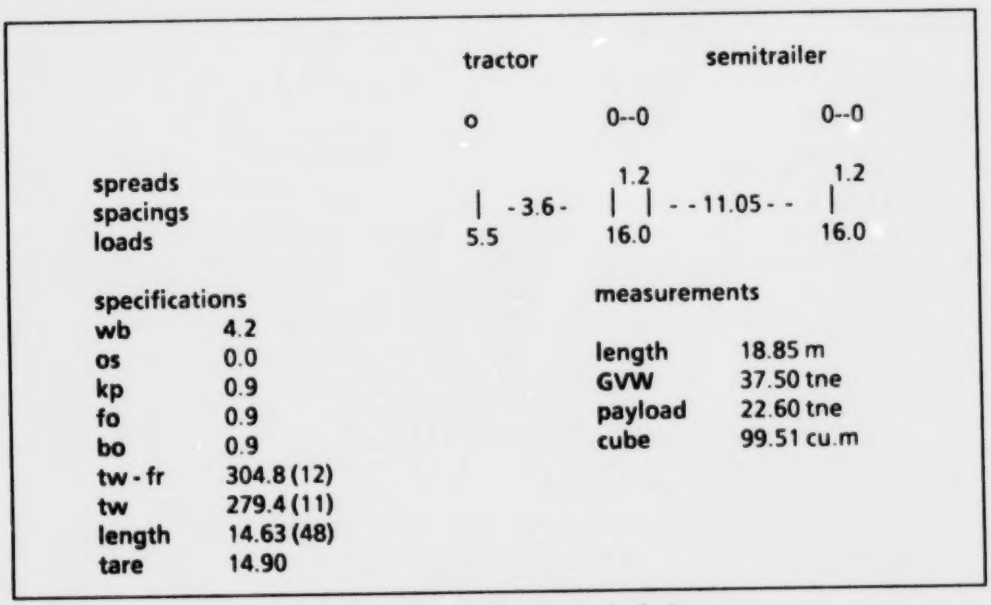


Table 3 Standard 3-S2, Ten Jurisdictions

constrained by the limit in the Yukon; and third, the tandem load is constrained by the regulations in the Prairie provinces (and, at 1.2 m, by Atlantic Canada).

Ignoring two of the constraints (the Northwest Territories, and the Yukon), a more common five-axle tractor semitrailer is shown in Table 3. This is a typical unit, with a 48-foot semitrailer, in many parts of the country -- the axle loads and GVW shown being set at the limits in the Prairie provinces. The configuration in Table 3 has 12 inch front tires to accommodate the 5,500 kg load on the Prairies (5,500 kg on two 12 inch tires equals a loading of 9.02 kg/mm). This same configuration is common in the other seven provinces with somewhat higher axle loads and GVWs and slightly different axle spreads/spacings.

6.3 MAXIMIZING CUBE

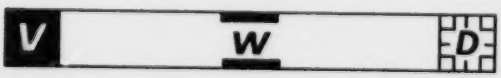
One issue faced by carriers is how to maximize available cube given the limits imposed by the dimensional elements of the regulations. There is no single solution to this as each type of freight and/or hauling situation favours certain types of equipment over others. For example, wood chip haulers use truck-plus-trailer combinations with enormous cubes made possible by building the cargo compartment out over the drivers' compartment and down as low on the vehicle frame as is physically possible. Household goods carriers (and others) use vans with "drop-frames" to increase cube. LTL carriers often prefer double-trailer configurations as the individual trailers in these units can minimize terminal costs as well as be used in city pickup and delivery.

For here, the ability to maximize cube under various regulations is considered in one simple context -- a standard van. Since width and height regulations are more-or-less uniform across the country, this issue of cube can be reduced to one of considering available trailer length (although this does overlook certain cube possibilities available from features such as dropped frames). Three possibilities can be considered: a tractor-semitrailer a tractor-semitrailer with a dromedary ("drome") on the tractor, and a double-trailer configuration.

6.3.1 Tractor-Semitrailer

Considering the first cube-maximizing possibility, the provinces may be divided into five groups.

- Those where available semitrailer length is limited to 13.5 metres (44.3' probably rounded to 45'): Yukon.
- Those where available semitrailer length is limited to 14.63 metres (48'): Newfoundland, Nova Scotia, New Brunswick, Ontario, Saskatchewan, and British Columbia.
- Those where the available semitrailer length is limited to 15.5 metres: Quebec.
- Those where available semitrailer length is unconstrained, but overall combination length limits of 20 metres control the available trailer cube.



In these situations, semitrailers with a length of more than 15.5 metres (50') are possible: Prince Edward Island, Manitoba, Alberta.

- Those where available semitrailer length is unconstrained, but overall combination length limit of 21.5 metres control the available trailer cube. It is not known what the practical upper length is for semitrailers in the one jurisdiction (the Northwest Territories) where this is possible.

6.3.2 Tractor-Semitrailer with Drome

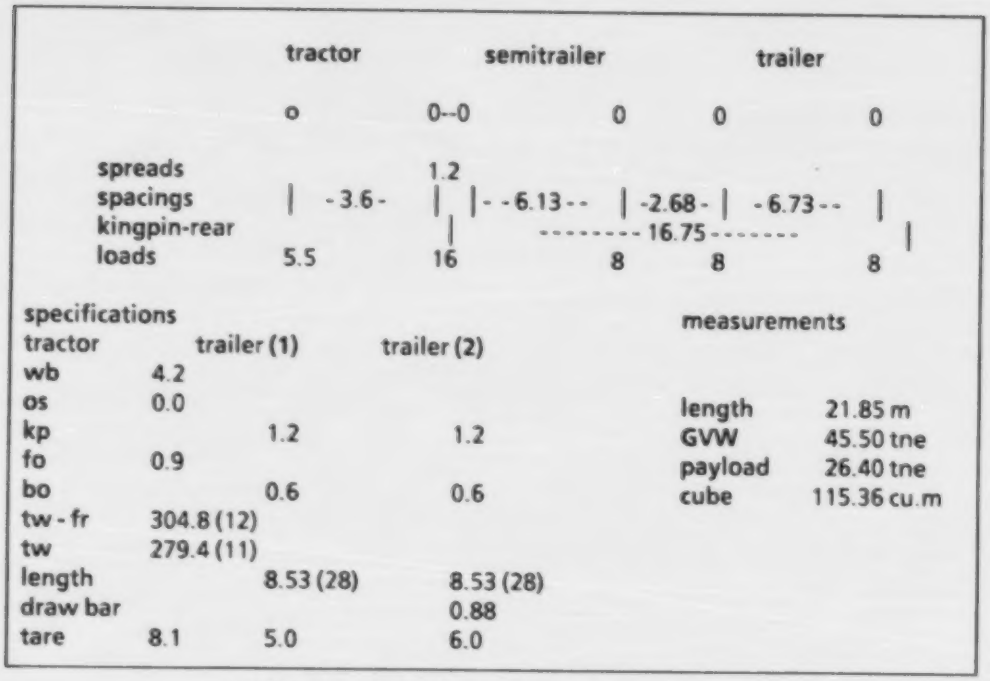
Considering the second cube-maximizing possibility, the cube available under various regulatory regimes is not known with precision. The difficulty in making this calculation is that the size of the drome depends on the way the tractor is built. However, it is known that dromes of the following sizes are in use, and further where regulations permit (all but one case) are in use with 14.63 metre (48') semitrailers:

combination length limit	semitrailer length	drome length	total length	jurisdictions
20 m 65.6'	14.63 m 48'	2.74 m 9'	17.37 m 57'	Nfld, PEI, Man, Sask Alta, BC
21 m 68.9'	14.63 m 48'	3.66 m 12'	18.29 m 60'	NS, NB
23 m 75.5'	14.63 m 48'	5.49 m 18'	20.12 m 66'	Que, Ont

6.3.3 Double-Trailer Configurations

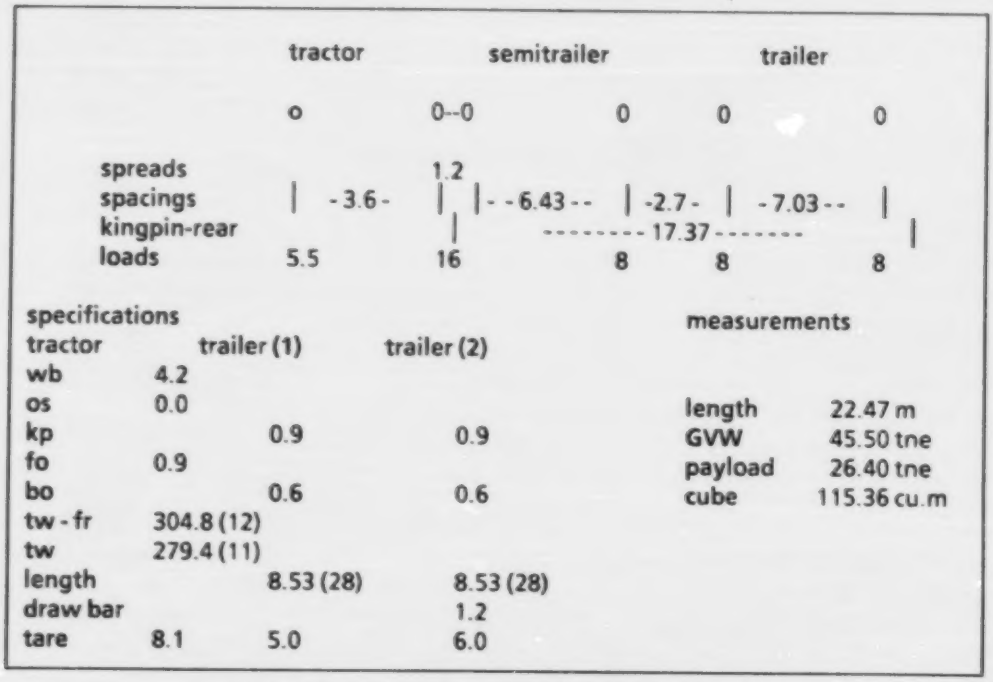
The third cube-maximizing possibility is more complex than the previous two as the kingpin-to-rear limit can become a limiting factor. In its original formulation, this limit of 16.75 metres was set to equalize the total trailer length available to carriers using both short and long wheelbase tractors. There is some disagreement as to just how much trailer length can be achieved in the face of this 16.75 metre limit: some carriers maintain that they cannot run double 28-foot pups with this limit; others are running double 28-foot pups, although the particular type of trailers used are not really giving the carriers a full 17.07 metres (56') of trailer length.

In Table 4, a hypothetical configuration of double 28-foot pups is shown that meets both the 16.75 metre kingpin limit and the 23 metre overall length limit. This is legal in seven jurisdictions (all but the Atlantic provinces and the Yukon). The axle loads and GVW are not critical: low values have been shown as this configuration would be used typically for LTL freight which fills the available cube of a van before it reaches even the weight shown in Table 4. There are two critical specifications



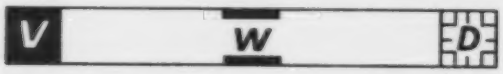
specifications				measurements	
tractor		trailer (1)	trailer (2)		
wb	4.2				
os	0.0			length	21.85 m
kp		1.2	1.2	GVW	45.50 tne
fo	0.9			payload	26.40 tne
bo		0.6	0.6	cube	115.36 cu.m
tw - fr	304.8 (12)				
tw	279.4 (11)				
length		8.53 (28)	8.53 (28)		
draw bar			0.88		
tare	8.1	5.0	6.0		

Table 4 Double 28' Pups, Seven Jurisdictions



specifications				measurements	
tractor		trailer (1)	trailer (2)		
wb	4.2				
os	0.0			length	22.47 m
kp		0.9	0.9	GVW	45.50 tne
fo	0.9			payload	26.40 tne
bo		0.6	0.6	cube	115.36 cu.m
tw - fr	304.8 (12)				
tw	279.4 (11)				
length		8.53 (28)	8.53 (28)		
draw bar			1.2		
tare	8.1	5.0	6.0		

Table 5 Double 28' Pups, No Kingpin-Rear Limit



that make it comply (just) with the most limiting aspects of the regulations and make it somewhat impractical as an operating vehicle. First, a kingpin setback of 1.2 metres (48") is so far back that there can be problems in placing the landing gear in a trailer such as this (it tends to be nose heavy). Second, the distance between the two trailers is only 0.88 metres*, which is probably not enough clearance for ordinary trailers in turning manoeuvers (many of the double 28-foot configurations seen on the road have tapered or "bull-nosed" front ends).

A double 28-foot combination that is easier to configure (ie, does not have to meet the 16.75 metre kingpin limit) is shown in Table 5. Compared to the one shown in Table 4, this one has kingpin setbacks of 0.9 metres (35") and a more reasonable drawbar distance of 1.2 metres (47"). As indicated in Part 5, five of the seven jurisdictions that allow A-trains now allow, or are planning to allow the kingpin limit of 16.75 metres to be exceeded. A sixth (the Northwest Territories) does not have a kingpin limit. This leaves Manitoba as the only jurisdiction (other than Atlantic Canada and the Yukon) where the double 28-foot configuration shown in Table 5 would not be legal (although in two of the other provinces it would have to operate under a special permit until the formal change in the regulations.)

6.4 MAXIMIZING LOAD

A second common problem faced by carriers is to use a truck that maximizes load. The number of possibilities is large, given the characteristics of various freight. For here, the possibilities are reduced by considering only available axle-load and GVW limits; particular types of cargo compartments are ignored (tanks, dumps, etc.) as are density and other characteristics.

In a simple sense, the load-maximizing differences among the provinces can be seen in Table 1. That is, jurisdictions with higher axle and/or GVW limits allow more load in a given truck than other jurisdictions. This, however, is where the over-simplifications in Table 1 render some of the information insufficient. For here, load maximizing abilities are looked at under three cases: straight trucks (without trailers), tractor-semitrailers, and any type of combination.

6.4.1 Straight Trucks

Straight trucks cannot maximize cube or load under any of the regulatory regimes. Nevertheless, straight trucks are an important part of the total truck fleet and there are differences in the way the regulations treat these vehicles. Further, some regulatory detail can be dealt with here (where there are fewer axles to consider) rather than in later sections.

Allowing all aspects of the vehicle to vary (tire size, spacings, number of axles), the maximum GVW possible for a straight truck is shown in Table 6. While allowing as many characteristics as this to vary makes the Table difficult to interpret,

---

* *To be precise, 0.8812 m in the configuration shown in Table 4. The limit for the clearance between the two trailers (given a 48" kingpin setback) is 35.4" : 336 - 48 + 35.4 + 336 = 659.4" (16.75 m).*

it allows a number of aspects of the regulations to be dealt with a this point. (In subsequent Tables, some vehicle specifications can be held constant for easier interpretation.)

The maximum load on a straight truck is reached with four axles in all provinces except Prince Edward Island, Ontario, and the Yukon. In Prince Edward Island, three-axle trucks are the largest permitted under the standard regulations, although larger ones may operate under special permit. In Ontario and the Yukon (the regulations are identical), the bridge formula allows a number of possibilities; one particular example, a five-axle truck (unrealistic), is shown at the bottom of Table 6. No information is shown for the Northwest Territories as the axle-spacing requirements are unclear: a four-axle straight truck can operate at 29,256 kg. The first two axles in all cases except Prince Edward Island, Ontario, and the Yukon constitute a tandem-front-steering axle with large single tires. Tire size (in inches) is shown in the fifth column of the Table.* Where no tire size is shown (Nova Scotia and Quebec), the manufacturer's rating is the governing regulation.** Axle spreads have been set wide enough to carry the loads shown in those provinces requiring axle spreads: in the case of Quebec and the Prairie provinces where no axle spread requirements exist for the vehicle shown, it is assumed that 1.2 metres is the minimum practical spread. In the particular case of Alberta, the 2.4 metre tandem-drive axle is unrealistic: use of such a wide-spread tandem only adds 800 kg to the allowable GVW, and it is understood that there are very few (if any) of these axles in use. Other details on the regulations, in particular the spacings shown in Table 6, are contained in Vehicle Weight and Dimension Regulations in Canada.

There are four points to note about the information in Table 6. First, the issue of whether or not these are realistic trucks (given some of the spacings and loads) is ignored as it is the paper differences in the regulations under consideration. Second, the maximum load on a straight truck may be obtained with anywhere from three to five axles, depending on the jurisdiction. Third, the maximum GVW on a straight truck (barring special permits) varies from a low of 26.1 tonnes in Prince Edward Island to a high of 47.5 tonnes in Ontario and the Yukon.

Fourth, given the minimum spread/spacing requirements in the regulations, the total allowed load in each province, divided by the distance between the first and last axle, varies from a low of 3.5 tonnes/metre in Alberta to a high of 6.9 tonnes/metre in Quebec. This does not mean there are trucks operating with loads of this magnitude as this analysis has pushed the regulations to the limit in the sense of taking the highest possible loads over the shortest possible distance whether or not the results are practical. The 3.5 tonnes/metre in Alberta is a result of the (unrealistic) 2.4 metre drive tandem: with this removed the load/metre becomes 4.0 and Saskatchewan becomes the jurisdiction with the lowest allowed load at 3.6 tonnes/metre.

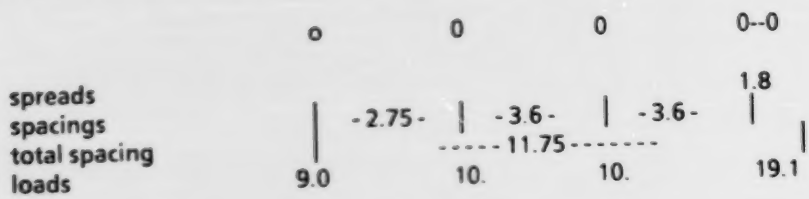
---

* *In two cases, the tires are slightly smaller than required. However, they are so close (11.07 kg/mm in Ontario and 9.02 kg/mm in Saskatchewan) it is assumed these "violations" would be ignored.*

** *Manufacturer's ratings are also a factor in other jurisdictions.*

	axle load		GVW	front	axle spacing				Load/
	front (tne)	drive (tne)	(tne)	tire size	#1-2 (m)	#2-3 (m)	#3-4 (m)	total (m)	metre (tne/m)
Nfld	17.0	17.0	34.0	17	1.50	3.34	1.50	6.34	5.362
PEI	9.1	17.0	26.1	18	3.66	1.52		5.18	5.035
NS	17.0	17.0	34.0	-	1.50	3.30	1.50	6.30	5.397
NB	17.0	17.0	34.0	16	1.50	4.25	1.50	7.25	4.690
Que	17.5	20.0	37.5	-	1.20	3.00	1.20	5.40	6.944
Man	16.0	16.0	32.0	18	1.20	5.00	1.20	7.40	4.324
Sask	11.0	16.0	27.0	12	1.20	5.00	1.20	7.40	3.649
Alta	13.6	16.8	30.4	16	1.20	5.00	2.40	8.60	3.534
BC	17.0	17.0	34.0	16	1.50	5.00	1.50	8.00	4.250

Ont & Yukon (one possibility)



front tire size: 16 in
GVW: 47.5 tne
tne/metre: 4.043

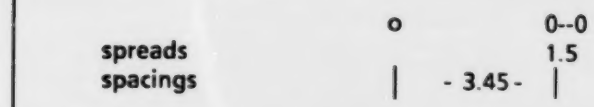
Table 6 Straight Trucks: Maximum Load

Another way of comparing the differences in the regulations is to take a given straight truck and show how the allowed axle loads and GVW vary from one jurisdiction to another. This has been done in Table 7 where a three-axle straight truck with a wheelbase of 4.2 metres and front tires of 18 inches* is shown.

One feature to note about this straight truck is that in three provinces the allowable GVW is less than the sum of the axle loads as the load-penalty provisions of the regulations come into effect. If a shorter wheelbase truck had been used, these load-penalty provisions would have come into effect in more provinces. However, the three cases shown are enough to give the general idea of how the regulations work to keep the total load spread over certain distances (the distances varying from one jurisdiction to another). In the case of Saskatchewan, the regulations require 3.5 metres between the steering axle and the first drive axle if the full axle loads are to be allowed. Failing this, the allowable GVW is reduced by 1,400 kg for every 0.3 metres less than the required spacing (so, in the truck shown, the GVW has

* *These tires are larger than necessary in some provinces, but have been set this large to satisfy the most restrictive case.*

straight truck



specifications		measurements				
wb	4.2		axle loads (tne)		sum of axles	GVW
tw - fr	457.2 (18)		front	tandem		
tw	279.4 (11)					
		Nfld	9.0	17.0	26.0	26.0
		PEI	9.1	16.3	25.4	25.4
		NS	9.0	17.0	26.0	26.0
		NB	9.0	17.0	26.0	26.0
		Que	8.5	18.0	26.5	26.5
		Ont	9.0	17.9	26.9	26.9
		Man	7.3	16.0	23.3	23.3
		Sask	5.5	16.0	21.5	20.1
		Alta	7.3	16.0	23.3	21.9
		BC	9.1	17.0	26.1	25.0
		Yukon	9.0	17.9	26.9	26.9
		NWT	6.5	16.3	22.8	22.8

Table 7 Given Straight Truck, Different Regulations

been reduced from 21,500 kg to 20,100 kg). The regulations in Alberta are slightly different in that there is a chart showing allowable front-axle loads given certain spacings between the front axle and the first drive axle. In the example shown, since the spacing is less than 3.5 metres, the allowed front axle load is only 5,900 kg (versus the 7,300 kg shown) and the allowable GVW is reduced to 21,900 kg. In the case of British Columbia, one master regulation (a chart) governs all loads for both axle spreads and axle spacings independent of the type of axle and/or configuration being considered. In the case shown in Table 7, the maximum load allowed for a spacing of 4.95 metres between the first and the third axle is 25,000 kg. (British Columbia is one of the few jurisdiction to use outer spacings in its load/spacing regulations.)

As can be seen from Table 7, this straight truck, if it were used in all twelve jurisdictions, would be allowed a GVW of anywhere from 20.1 to 26.9 tonnes -- a payload difference of 6.8 tonnes. While it is unlikely that this particular truck would be used in all twelve jurisdictions (trucks tend to be built for certain regulatory regimes), this diversity in the regulations has an impact on everything from resale values to equipment mobility.

6.4.2 Tractor-Semitrailers

Continuing with the issue of load maximization, Table 8 shows the maximum load available for tractor-semitrailers in various jurisdictions. Tractor-semitrailers

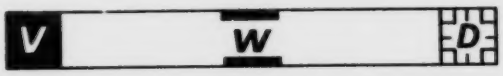
are considered here, prior to considering any and all combinations in the next section, to demonstrate a simple point: the regulations of some jurisdictions allow the maximum or close to the maximum GVW to be achieved on tractor-semitrailers; others do not.

The configurations shown in Table 8 are not necessarily realistic; in particular, the high front axle loads in Prince Edward Island, New Brunswick, and British Columbia and the 2.4 metre spread tandems in Alberta are probably rare in the real world. Nevertheless, and before considering a more realistic tractor-semitrailer, there are two points to note. First, the provinces divide into three groups: the four that only recognize two-axle semitrailers, the six that permit three-axle semitrailers, and the two that allow many axles on a semitrailer. There are two qualifications to this: one of the 3-S3 provinces (Quebec) is now allowing four-axle semitrailers under special permit, and Ontario and the Yukon do not actually limit the number of axles on a semitrailer to five (some six-axle semitrailers exist, but five are all that are necessary to achieve the maximum GVW). The second point to note is that from Ontario east it is generally possible to either reach or come close to the maximum GVW with a tractor-semitrailer; from Manitoba west (with the exception of the Yukon) it is not possible to reach or come close to the maximum GVW with a tractor-semitrailer. In terms of load maximization, then, there is a clear incentive to use doubles in Western Canada.

	Configuration	GWV (kg)	Percent of max GVW	Notes
Nfld	3-S3	48,500	92.4%	4,500 kg front axle
PEI	3-S3	53,297	100.0	20,000 lb front axle; hard conversion to metric
NS	3-S3	50,000	100.0	6,000 kg front axle
NB	3-S3	53,000	93.8	9,000 kg front axle
Que	3-S3	57,500	100.0	7,500 - 8,500 kg front axle
Ont	3-S5	63,500	100.0	various possibilities
Man	3-S2	37,500	66.4	5,500 kg front axle
Sask	3-S2	37,500	70.1	5,500 kg front axle
Alta	3-S2	40,900	76.4	7,300 kg front axle; wide-spread tandems
BC	3-S3	52,200	82.2	9,100 kg front axle
Yukon	3-S5	63,500	100.0	various possibilities
NWT	3-S2	39,012	71.6	6,500 kg front axle

Table 8 Tractor-Semitrailers: Maximum Loads

In Table 9, two tractor-semitrailers are shown, one (the 3-S3) a common configuration in Eastern Canada and the other (3-S2) a common configuration in Western Canada. "Common" is a tricky word as in fact the 3-S2s and 3-S3s in some provinces tend to be built for the regulations of that province. However, the point being shown in Table 9 is an imaginary "what if" question: what if the 3-S2 or the 3-S3 shown were used in a cross-Canada haul? Given fixed tire sizes (11 inches), a fixed



wheelbase (4.3 metres), and fixed axle spreads and spacings, the only variables in the analysis are the loads allowed. Axle spacings have been carefully set so that the load-penalty provisions of most regulations are not a factor (they only have an effect in British Columbia*), and a 45-foot semitrailer is used so that two minor aspects of the regulations (British Columbia and the Yukon**) do not interfere. Further, in the two provinces were manufacturer's ratings are the only factors governing tire loads, a value of 11 kg/mm has been assumed (this is the highest allowed load in any other jurisdiction).

The figures in Table 9 speak for themselves. Again, it is emphasized that it is only the differences in the regulations as they are written that are examined here. In actual practices, there are a number of problems with the information shown in Table 9: Prince Edward Island probably "rounds" the allowed loads to values similar to those in the other Atlantic provinces (the ones shown in Table 9 are strict interpretations and conversion of the Imperial regulations); few combinations would have quite the control over front axle loads as those indicated in Table 9; tolerances (official or unofficial) at the weigh scale would minimize some of the differences shown; etc.

6.4.3 All Combinations

As a final step in considering load maximization possibilities under the different regulations, Table 10 shows the maximum GVW possible in each province, the number of axles required to achieve this maximum, the configurations that can be used, and the "theoretical" minimum spacing required for these loads. This last item is "theoretical" in the sense that again the regulations are being pushed to the limit with the highest possible loads calculated over the shortest possible distance.

In terms of the calculations, there are two assumptions: first, axle spreads in the Prairie provinces are assumed to be 1.2 metres; second, in the case of Quebec where the distance from the steering axle to the first drive axle is not regulated, it is assumed that the minimum practical distance for this is 3.0 metres. Other more specific points to note about the calculations and/or information shown in Table 10 are:

- NEWFOUNDLAND: The highest GVW of 52.5 tonnes may only be reached with two combinations -- a truck-plus-trailer (3-4) or a seven-axle B-train (3-S2-S2). In either case, the axle spreads and spacing required are identical.

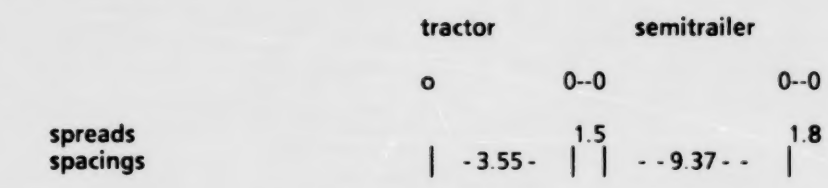
- PRINCE EDWARD ISLAND: The highest GVW is 117,500 lbs (53,297 kg) on a six-axle tractor semitrailer (3-S3), with a high front-axle load of 20,000 lbs (9,072 kg).

---

* *Given spacing of 4.8 metres between axle #4 and #6, the total load allowed is 25,000 kg.*

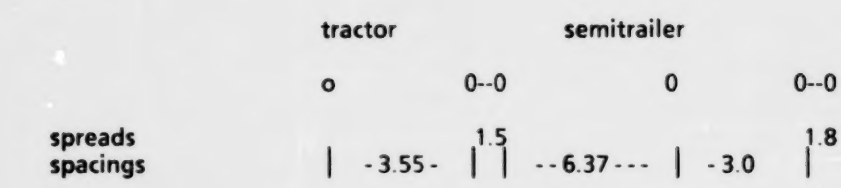
** *Yukon only permits 45' semitrailers; British Columbia restricts the use of tri-axles to 45' (or shorter) equipment and requires that the third axle is self-steering.*

A) Given 3-S2



specifications		axle loads, GVW, payload (tne)					
wb	4.3		front axle	tandem axle	tandem axle	GVW	pay-load
os	0.0						
kp	0.9						
tw - fr	279.4 (11)	Nfld	4.50	17.00	18.00	39.50	24.60
tw	279.4 (11)	PEI	5.98	17.01	17.01	40.00	25.10
length	13.72 (45)	NS	6.15	17.00	18.00	41.15	26.25
tare	14.90	NB	5.98	17.00	18.00	40.98	26.08
		Que	6.15	18.00	19.00	43.15	28.25
		Ont	6.15	17.90	19.10	43.15	28.25
		Man	5.03	16.00	16.00	37.03	22.13
		Sask	5.03	16.00	16.00	37.03	22.13
		Alta	5.03	16.00	16.40	37.43	22.53
		BC	6.15	17.00	17.00	40.15	25.25
		Yukon	6.15	17.90	19.10	43.15	28.25
		NWT	4.47	16.26	16.26	36.98	22.08

B) Given 3-S3



specifications		axle loads, GVW, payload (tne)					
wb	4.3		front axle	tandem axle	tandem axle	GVW	pay-load
os	0.0						
kp	0.9						
tw - fr	279.4 (11)	Nfld	4.50	17.00	27.00	48.50	32.60
tw	279.4 (11)	PEI	5.98	17.01	26.08	49.07	33.17
length	13.72 (45)	NS	6.15	17.00	27.00	50.00	34.10
tare	15.90	NB	5.98	17.00	27.00	49.98	34.08
		Que	6.15	18.00	29.00	53.15	37.25
		Ont	6.15	17.90	29.10	53.15	37.25
		Man	5.03	16.00	16.00	37.03	21.13
		Sask	5.03	16.00	16.00	37.03	21.13
		Alta	5.03	16.00	16.40	37.43	21.53
		BC	6.15	17.00	25.00	48.15	32.25
		Yukon	6.15	17.90	19.10	53.15	37.25
		NWT	4.47	16.26	16.26	36.98	21.08

Table 9 Given 3-S2 & 3-S3 Configurations, Cross-Canada Haul

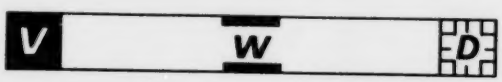
- NOVA SCOTIA: Similar to Newfoundland, the regulations show the maximum GVW reached on a seven-axle truck-plus-trailer or a seven-axle B-train. However, because Nova Scotia's regulations allow higher front-axle loads to be added to maximum GVW, it is possible to reach the limit of 50.0 tonnes on a six-axle tractor-semitrailer. The front axle has to carry 6,000 kg.

- NEW BRUNSWICK: On primary highways, a GVW of 56.5 tonnes is possible with either a seven-axle truck-plus-trailer or a B-train. Axle spacing requirements for both combinations are identical and higher than in the other Atlantic provinces (approaching the spacing requirements of the Prairie provinces).

	Maximum GVW (tne)	# of axles		Configuration	Spacing 1st to last axle (m)	Load per metre (tne/m)
Nfld	52.5	7		3-S2-S2	15.14	3.468
		7		3-4	15.14	3.468
PEI	53.3	6		3-S3	14.33	3.719
NS	50.0	6		3-S3	13.60	3.676
NB	56.5	7		3-S2-S2	17.10	3.304
		7		3-4	17.10	3.304
Que	57.5	6		3-3	14.00	4.107
		6		3-S3	14.10	4.078
		6		3-S1-2	17.00	3.382
Ont	63.5	8		any	18.25	3.479
Man	56.5	8		3-S2-3	13.76	4.106
Sask	53.5	7		3-S2-S2		
			or	3-4	17.10	3.129
				3-S2-2	16.90	3.166
Alta	53.5	7		3-S2-S2		
			or	3-4	16.60	3.223
				3-S2-2	16.40	3.262
BC	63.5	8		3-S2-3	17.50	3.629
				3-S3-S2	17.20	3.692
Yukon	63.5	8		any	18.25	3.479
NWT	54.5	7		3-4		
			or	3-S2-S2	15.14	3.600

Table 10 Maximum Loads: Any Combination

- QUEBEC: There are a variety of possibilities in Quebec: three are shown in Table 10. The main points are that it takes six axles to reach the GVW limit of 57.5 tonnes and that the spacing requirements vary depending on the configuration. With 3.0 metres between the steering axle and first drive



axle assumed (this is not regulated), the 57.5 tonnes may be spread over anywhere from 14.0 to 17.0 metres.

- ONTARIO: The maximum GVW of 63.5 tonnes can only be obtained with eight-axle equipment. However, seven-axle combinations come so close to the maximum (63.3 tonnes given a high front-axle load) that many carriers use these combinations rather than eight-axle ones. Given ideal axle loadings, it can be shown on paper that the addition of an eighth axle actually adds more tare weight to a truck than it does allowable payload: however, not many trucks can reach this state of ideal axle loadings in practice. Given the use of eight axles, the minimum distance from the first to last axles allowed under the bridge formula is 18.25 metres no matter what the combination.

- MANITOBA: On primary highways the highest GVW of 56.6 tonnes may only be reached with an eight-axle A-train. Although most such A-trains would have a total spacing between the first and last axle of 18.6 metres, it is possible to reduce this to 13.76 metres through the judicious loading of axles (in actual operations this is not really practical).

- SASKATCHEWAN: The highest GVW of 53.5 tonnes on primary highways can be reached with any double combination (truck-plus-trailer or train).

- ALBERTA: The regulations in Alberta are similar to those in Saskatchewan: the only difference that shows on Table 10 is that the spacing requirements between the steering axle and the first drive axle is shorter. (In addition, and not shown on the Table, Alberta is now special permitting eight-axle A-trains at 62.5 tonnes).

- BRITISH COLUMBIA: There are a number of possibilities in British Columbia, two of which are shown in Table 10. The points to note are that it takes a double combination to reach the highest GVW and that with these combinations the front-axle load is held to 6,000 kg.

- YUKON: The regulations are identical to those in Ontario.

- NORTHWEST TERRITORIES: The distance between the steering axle and the first drive axle is assumed to be 3.0 metres. The distance between the tandem axles in a seven-axle truck-plus-trailer or B-train have to be a minimum of 14 feet (this seems to be independent of either the axle loads or total GVW).

7. Regulations and Trucking Part II: Cost Considerations

7.1 TRUCK SIZE AND TRUCKING COSTS

Large trucks can haul freight at lower unit costs than small trucks: size here is either in volume or weight, so that the relevant cost measures are either dollars per tonne-kilometre or dollars per cubic metre-kilometre.

As an example of the difference in trucking costs for weigh-out freight, the following shows the 1986 costs of different sized tank trucks in Saskatchewan. The eight-axle A-train is a hypothetical configuration using Ontario axle loads and no GVW limit. The costing methodology, described in a Background Paper, includes only operating costs; there is no allowance for administration or profit.

Axles	Configuration	GVW (tne)	Payload (tne)	$/tne-km
5	3-S2	37.5	24.5	$0.0258
7	3-S2-2	53.5	33.0	$0.0217
8	3-S2-3	76.3	55.8	$0.0143

As another example, more appropriate for cube-out freight, a 1985 U.S. study on longer combination vehicles developed an empirical measure for operating costs per mile for a number of combinations. [15] These are typical of for-hire LTL operations. For here, the absolute values are not as important as are the relative differences between the various combinations (the source figures are in 1982 U.S. dollars). While slightly different cost structures in Canada will affect the "slope" of this relationship, the following figures are still a good approximation to the differences in costs per cubic-metre-kilometre for light density freight operations.

Configuration	Trailers (in feet)	Cost per km Index	Cost per cubic-metre-km	Index
semitrailer	45'	100.0	100.0	
	48'	100.0	93.7	
double	27'/27'	106.8	89.0	
	28'/28'	106.8	85.8	
Rocky Mtn double	45'/28'	120.8	74.4	
	48'/28'	120.8	71.5	
turnpike double	45'/45'	125.9	63.0	
	48'/48'	125.9	59.0	

The relationship between vehicle weight and/or vehicle cube and unit costs varies considerably from one situation to another. Nevertheless, the figures from both of the above examples suggest that (roughly) a doubling of vehicle weight or a doubling of vehicle cube reduces unit cost by 35 to 45 percent. To reiterate the proposition stated earlier: large trucks can haul freight at lower costs than small trucks. This has been established many times and the interest here is not so much in determining the exact slope or intercept of some cost curves as it is to examine where and how these cost differences impact shippers' costs.

7.2 WEIGHT AND DIMENSION REGULATIONS AND SHIPPING COSTS

Proving that large trucks can carrying freight at a lower cost than small trucks is one thing; demonstrating that different weight and dimension regulations actually have an impact on shippers' costs (truckers' rates) is more difficult. The problem is finding appropriate data. In this research, two approaches were taken: a specific case study in Saskatchewan where all details on regulatory change and truck industry response were available; and a more general approach making use of the trucking statistics from Statistics Canada.

Neither of these approaches results in a global estimate of the impact of regulatory change on shippers' costs. That is, the findings have not been used to make an estimate of the total impact of different weight and dimension regulations on all trucking activity. Such a macro estimate is possible, of course, if one is willing to make heroic assumptions -- the most critical one being that something is known about the relationship between the characteristics of the trucking activity examined and the characteristics of all other trucking activity.

7.2.1 Saskatchewan Petroleum Haulers

Hauling petroleum products within Saskatchewan offers an ideal laboratory for examining the impact of changes in weight and dimension regulations. [16] First, the commodity is relatively homogeneous so that any data on this segment of the trucking industry is not "confused" with different mixes of freight types or hauling situations. Second, there are only a few large shippers who are sophisticated and who have used (particularly in other provinces) private carriage to move their goods: this has an impact on trucking rates in that they tend to be more cost-based and more responsive to regulatory change than otherwise would be the case. Third, this is a regulated (economic regulation) trucking situation. The importance of this is twofold: first, even though at times the rate-making process is more negotiation (between carriers and shippers) than regulation, the existence of a regulatory process has provided a public record of the resulting rates and the process; second, the existence of a regulatory agency has encouraged the extent to which the rate schedules reflect costs (regulatory personnel tend to use cost models that suggest such things as lower costs, hence rates, when larger trucks are used). Fourth, there have been two significant changes in the regulations in Saskatchewan: in 1974 the 18/32/74 kip standard was changed to 20/35/110 kips on the primary highways*; and, in 1982 the primary highway GVW limit was further increased to 118,000

---

* *That is, 20,000 lbs on single axles, 35,000 lbs on tandem axles, and 110,000 lbs on GVW (the "soft" metric equivalent values became 9/16/50 tonnes.*

pounds (53.5 tne) and more importantly the secondary highway limits were raised to 18/32/108 kips allowing the effective use of double-trailer combinations on secondary roads.* (There were also length limit increases throughout this period.) The importance of this is that, unlike a series of small regulatory changes that are hard to track, these changes were large and discrete enough to have a measurable impact on trucking.

While the changes in weight and dimension regulations took some time to fully affect the characteristics of tank trucks, an abbreviated version of the changes is:

- PRE 1974: The standard combination used to haul petroleum products was a five-axle tractor semitrailer with a payload of roughly 46,000 lbs (20.9 tne).

- 1974 - 1982: On the primary highways, it became possible to use seven-axle doubles (A- or B-trains) at GVWs of 110,000 pounds with payloads of 72,000 lbs (32.7 tne).

- POST 1982: On the primary highways, seven axle doubles are still used with GVWs of 53,500 kg (118,000 lbs) and payloads of over 30 tonnes (the highest truckload lot in the tariffs is for 78,000 lbs or 35.4 tne). On the secondary highways where many of the destinations for petroleum products are located, it now is possible to use these same doubles with payloads of about 69,000 lbs (31.3 tne).

With these changes, the carriers, shippers, and the regulatory agency developed a series of new rates. A few of these, at select shipping distances, are shown in Table 11:

- APRIL 1974: Prior to the highway strengthening program and the change in weight and dimension regulations, the lowest rate in the tariff was for shipments in a "74,000 lbs GVW load" -- that is, a truck registered at the highest legal GVW with a payload of about 46,000 lbs.

- NOVEMBER 1976: Although individual carriers and shippers had been negotiating new rates made possible by the larger equipment coming into use on the primary highways, the first change in the industry tariff occurred in November 1976 when a new 72,000 lb rate was introduced.

- FEBRUARY 1980: The minimum shipment sizes were all increased in the tariff: the 46 kips rate became 47 kips, the 72 kip rate became 73.5 kips. These increases were the result of gradually improving tare weights, and, hence, higher possible payloads.

- MARCH 1982: As a result of the regulatory changes in 1982 (slightly higher GVWs on the primary roads, and a large jump in GVWs on secondary roads at the old axle limits), several new rates appeared in the

---

* *There were also length limits increases throughout this period.*

		ship. size (kips)	- cents/cwt - . . shipping distance (miles) . . 100	200	300	400	500
April	1974	46	10.9	19.5	29.2	38.9	48.7
Sept.	1974	46	20.9	39.9	58.8	77.8	-
Nov.	1976	72	24.1	46.1	67.9	89.8	112.3
May	1978	46	32.9	64.6	96.4	128.2	159.9
		72	26.5	52.1	77.8	103.4	129.0
Feb.	1980	47	40.7	76.6	112.5	148.4	184.3
		52.3	36.5	68.6	101.1	133.4	165.6
		73.5	32.2	60.7	89.2	117.7	146.2
March	1982	47	51.6	99.6	147.6	195.6	243.6
		53.5	45.3	87.5	129.7	171.8	214.0
		69.0	43.1	83.8	124.5	165.2	206.0
		75.0	42.0	81.7	121.4	161.1	200.8
		78.0	41.4	80.5	119.6	158.6	197.7
Oct.	1983	47	45.0	88.0	130.9	173.8	216.7
		53.5	39.6	77.3	115.0	152.7	190.4
		69.0	37.2	72.5	107.7	143.0	178.2
		75.0	34.6	67.5	100.3	133.1	166.6
		78.0	33.5	65.2	97.0	128.8	160.6

Table 11 Saskatchewan Petroleum Product Trucking Rates
(contract rates, carrier-supplied trailers)

		ship. size (kips)	- cents/cwt - . . shipping distance (miles) . . 100	200	300	400	500
April	1974	46	22.5	40.2	60.2	80.2	100.4
Sept.	1974	46	43.1	82.3	121.2	160.4	-
Nov.	1976	72	41.3	78.9	116.3	153.8	192.3
Feb.	1980	73.5	37.7	71.0	104.3	137.7	171.0
March	1982	78	39.0	75.8	112.6	149.3	186.2
Oct.	1983	78	29.8	57.9	86.1	114.4	142.6
mid-	1986	78	26.9	52.4	78.0	103.5	129.1

Table 12 Saskatchewan Petroleum Product Trucking Rates - 1981 dollars
(lowest contract rates, carrier-supplied trailers

tariff. The 69,000 lb rate was introduced for loads on the larger equipment (seven axle) now able to operate on secondary roads. The new 78,000 lb rate was for this same equipment on the primary roads.

- OCTOBER 1983: The rates introduced in 1983 have been frozen until 1988 (these are minimum rates only); the intent is to deregulate petroleum rates by 1988.

There have been many forces influencing these petroleum hauling rates over the period 1974 to 1986: sharp increase in fuel costs, reductions in tare weights, competitive pressures, and of course changes in weight and dimension regulations. In Table 12, the effect of all of these factors is shown by converting the rates to constant (1981) dollars: only the lowest possible rates (ie, for the largest minimum shipment size) are shown*. As can be seen, real petroleum hauling rates in 1986 are lower than they were in September 1974.

The extent to which changes in weight and dimension regulations are responsible for this decline in trucking rates can be gauged by comparing the current (1983) rates for 47,000 lb shipments with the current rates for larger shipments. That is, if the weight and dimension regulations had not been changed, petroleum would still be hauled in Saskatchewan in 46,000 lb (or 47,000 lb) shipments. Currently, the 78,000 lb rates are 74 percent and the 69,000 lb rates are 82 percent of the 46,000 lb rates: the changes in weight and dimension regulations in Saskatchewan have been responsible for a 26 percent decline in petroleum hauling rates on primary highways and a 18 percent decline on secondary roads.

7.2.2 Statistics Canada Data

Statistics Canada conducts a sample of shipping documents on an annual basis known as the "For-hire Trucking Survey." Full details on the scope, methodology, and limitations are reported elsewhere. [17] This is the best national source of trucking statistics available -- at least for one segment of the trucking industry -- the Class I and II for-hire carriers with respect to domestic shipments. These carriers had 1984 domestic shipping revenues of $4.1 billion (this excludes international shipment revenues and non-trucking related activities such as storage, packing, etc.). To put this in perspective, all trucking activity in Canada in 1984 is estimated to have accounted for $22 billion in operating expenses (see Part 2). In other words, the statistics analyzed represent only a fraction of total trucking activity. This is one of the reasons why it is believed that it would be difficult to extrapolate any findings to produce a global estimate of the impact of weight and dimension regulations. The characteristics of the larger for-hire carriers are likely quite different from the characteristics of all other truck operators.

The proposition tested in this analysis is that, because larger trucks hauling larger shipments can do so at lower rates, regulations allowing larger trucks will result in a greater proportion of large shipments than regulations which do not permit such trucks. An equally important part of the proposition, however, is that weight and dimension regulations are only one factor affecting shipment sizes: for

---

* *The index used was the transportation component of the CPI for Saskatoon and Regina.*

a number of reasons, shippers may want to ship commodities in shipment sizes that are not maximum in terms of the permitted vehicle weights and dimensions.

As regulations are changed to allow larger trucks, there are several possible consequences. First, assuming the industry adopts the use of larger trucks, potential costs per unit of freight decrease. This is **potential** in that the costs drop only if the larger load materializes and all other factors (eg, utilization, factor prices) remain relatively constant. Second, and depending on the competitive conditions, this potential drop in trucking costs may be passed on to shippers. This can happen in two ways: the general level of rates may decline, or more shipments may move at higher weights and thereby take advantage of the lower rates in these higher weight brackets. It is only this second possibility being tested here, and this is a second reason why the results have not been used to develop a global estimate for the impact of weight and dimension regulations.

The regulatory regimes (see Part 5) are:

- ATLANTIC CANADA: Maximum GVWs range from 50 tonnes in Nova Scotia (and on secondary roads in New Brunswick) to 56.5 tonnes on major highways in New Brunswick. The most important change occurred in 1978 when the region adopted the 9-tonne single axle, 18-tonne tandem axle (17 tonne if a drive-tandem), 27-tonne triple axle, 50-tonne GVW standard. For many commodities in Atlantic Canada, given origins or destinations off the primary highways or given a trip through Nova Scotia, 50 tonnes may be the effective GVW limit thereby limiting payloads to 30 to 35 tonnes depending on tare weights. In terms of cube, Atlantic Canada limits many combinations to an overall length of 21 metres, two metres shorter than the rest of the country.

- QUEBEC, ONTARIO AND BRITISH COLUMBIA: All three provinces adopted higher axle and GVW limits, including the recognition of triple axles, in the early 1970s. Although there have been minor changes since, one would expect that the regulatory impact on fleets regarding load limits would have worked its way through the system by 1981 (the first year of data from Statistics Canada). The major change after 1981 has been the increase in allowable lengths from 21 to 23 metre; in addition, Quebec allows longer-combination vehicles on divided highways under permit. In Quebec and Ontario, the increase in length limits to 23 metres has been implemented in such a way as to allow significant increase in available cube.

- PRAIRIES: The Prairie provinces adopted the 20/35/110 kip standard for single/tandem/GVW limits on their primary highways in 1974. In 1982, the provinces further increased GVW limits to 118 kip (Saskatchewan and Alberta) and 125 kip (Manitoba) and raised the limits on secondary roads to about 108 kips. Throughout this period, combination length limits were increased to 23 metres and all three provinces have been allowing longer and/or heavier vehicles under special permit in some circumstances.

Data for the years 1981, 1983, and 1985 was obtained from Statistics Canada; only some of this for truckload ("TL") shipments is described here. TL shipments have been arbitrarily defined as any shipment weighing between 5 and 50 tonnes (there are some large contract hauls evident in the data where "shipment" or more correctly "shipping document" weight exceeds 50 tonnes by a considerable amount). The analysis consisted of computing frequency distributions of TL shipments by shipment size, computing average TL shipment sizes, and computing revenues per tonne-kilometre as a measure of the trucking rates used for different sized shipments. Some of these computations show clearly the impact of weight and dimension regulations; some seem to raise more questions than answers; and some do not seem to show much of anything about weight and dimension regulations. These results confirm one of the early suspicions about the subject: the impact of weight and dimension regulations is more complex than has been generally realized.

The commodity groups analyzed represented 41 percent of total tonnage in 1985. In all cases, the commodity groups were selected on the basis of what were expected to be relatively homogeneous trucking situations; that is, commodities hauled in a similar manner (shipment size, packaging, handling, etc.) in all regions of the country.

GRAIN: Unmilled grain moves in TL lots in bulk, hopper-bottom trailers. Typically, this movement by for-hire carriers consists of secondary movements of grain, for example, from an elevator to a feed lot; primary or "off the farm" movements tend to be handled by private trucks (or "custom" trucking). In 1985, these grain movements accounted for 2,559,397 tonnes or 1.9 percent of the total tonnes of freight handled by Class I and II for-hire carriers.

The frequency distribution of TL shipments by shipment size is shown in Table 13. ("Atl" is Atlantic Canada, where there is insufficient data to show the individual provinces.) As shown, shipments are smaller in Atlantic Canada than in other regions: the average size for intraprovincial shipments in 1985 was only 14.0 tonnes. (The extraprovincial data for Atlantic Canada is based on a very small sample.) Conversely, shipment sizes are large in Central Canada where GVW limits are high: the average in Ontario for intraprovincial shipments for all three years exceeded 30 tonnes.

A point to note about the Ontario intraprovincial data is that the proportion of shipments in the highest weight class (40 to 49.9 tonnes) has been increasing even though there have been no changes in axle or GVW limits throughout the period 1981 to 1985: 11% of total tonnes in 1981, 15% in 1983, and 22% in 1985. Further, unless some grains cube out (and thereby benefit from the increase to 23 metres), there were no regulatory changes in the years immediately preceding 1981 to account for this growth in the proportion of shipments in this weight class. This might suggest that there are reasons other than the simple effect of one jurisdictions's weight and dimension regulations affecting shipment size.

A) INTRAPROVINCIAL		Atl	Que	Ont	Man	Sask	Alta	BC
1981								
5 - 9.9	tonne	0.0	0.5	0.2	2.1	0.2	1.2	0.0
10 - 19.9	"	62.4	17.7	2.2	22.7	0.9	5.0	10.7
20 - 29.9	"	37.6	18.8	9.5	67.5	98.5	84.0	75.4
30 - 39.9	"	0.0	57.3	77.1	7.7	0.3	8.9	13.9
40 - 49.9	"	0.0	5.8	11.0	0.0	0.0	1.0	0.0
1985								
5 - 9.9	tonne	0.0	0.2	0.2	1.8	0.1	1.8	1.3
10 - 19.9	"	100.0	13.0	4.9	11.9	2.2	6.6	0.0
20 - 29.9	"	0.0	8.8	18.4	53.4	27.4	47.1	44.6
30 - 39.9	"	0.0	77.7	54.6	30.6	67.2	43.4	54.0
40 - 49.9	"	0.0	0.4	22.0	2.4	3.2	1.0	0.0
B) EXTRAPROVINCIAL (by origin province)								
1981								
5 - 9.9	tonne	4.6	0.0	0.2	4.2	3.6	0.2	0.0
10 - 19.9	"	6.8	0.0	15.2	6.4	52.5	2.6	0.0
20 - 29.9	"	88.6	79.4	15.5	47.9	43.9	62.9	84.0
30 - 39.9	"	0.0	20.6	63.9	41.5	0.0	34.3	16.0
40 - 49.9	"	0.0	0.0	5.3	0.0	0.0	0.0	0.0
1985								
5 - 9.9	tonne	0.0	0.0	0.4	0.7	0.3	0.3	2.7
10 - 19.9	"	0.0	1.2	0.3	5.0	6.5	4.3	14.6
20 - 29.9	"	0.0	11.1	8.8	17.4	13.5	37.7	25.9
30 - 39.9	"	100.0	87.7	80.5	77.0	78.7	57.1	56.7
40 - 49.9	"	0.0	0.0	9.9	0.0	1.0	0.6	0.0

Table 13 Grain
(frequency distribution, by TL shipment size)

In the Prairies, there has been a general increase in the proportion of tonnes moving in the 30 to 39.9 tonne shipment range. This is the result of the increase in GVW limits on secondary roads in 1982.

		Total TL Tonnes in 30 - 30.9 tne Shipments					
		Manitoba '000 tne		Saskatchewan '000 tne		Alberta '000 tne	
A)	intraprovincial						
	1981	1.0	7.7%	1.0	0.3%	26.3	8.9%
	1983	1.6	7.0%	31.8	6.6%	99.4	24.0%
	1985	9.6	30.6%	125.2	67.2%	92.7	43.4%
B)	extraprovincial						
	1981	11.9	41.5%	0.0	0.0%	43.9	34.3%
	1983	14.7	45.7%	10.0	44.1%	62.0	38.9%
	1985	45.6	77.0%	30.8	78.7%	100.7	57.1%

In terms of rates, and using a Canada-wide average, shippers moving grain in 40 tonne or greater shipments are paying anywhere from 10 to 20 percent less, depending on shipping distance, than shippers moving grain in 30 to 39.9 tonne shipments. Shippers on the Prairies are paying on average 28 percent less to move their grain in 30 to 30.9 tonne shipments than they were when they were moving it in 20 to 29.9 tonne shipments.

BEVERAGES: Beverages account for two percent of total tonnages. No clear relationship between weight and dimension regulations and shipment size could be established for this commodity. In some cases, provinces with lower GVW limits consistently had more large TL shipments of beverages than those provinces with higher GVW limits; in other cases, provinces with similar regulations had quite different patterns of beverage shipments. Further, there were no apparent trends over time that corresponded with regulatory change. The proportion of this commodity group moving in large shipment sizes is relatively low (even in provinces where the regulations permit 40 tonne or greater shipments) and average TL shipment size in 1985 varied from a low of 12.0 tonnes (Manitoba) to a high of only 23.0 tonnes (Quebec).

There are several possible reasons to account for this lack of relationship between shipment size and weight and dimension regulations. The most obvious is that the mixture of various commodities within the beverage category vary from one province to another or from one year to another. Even if that is the case, there is an important observation: while weight and dimension regulations are undoubtedly an important factor in determining shipment size and, hence, the cost of moving goods by truck, there are clearly other factors at work. Reinforcing this observation, the analysis of rate levels for beverages showed that beverage shipments which move in shipment sizes exceeding 40 tonnes are doing so at rates of roughly half those applicable to the 30 to 39.9 tonne shipments. In other words, even though the regulations in many situations in Canada permit higher shipment sizes for beverages and even though the prevailing average rates offer a considerable incentive to do so, there are obviously other factors influencing shippers' choices.

LOGS AND PULPWOOD: Logs and pulpwood (Table 14) accounted for 4.6 percent of all Class I and II for-hire domestic tonnages in 1985. Most of this movement occurs in Atlantic Canada, Quebec, Ontario, and British Columbia, with virtually all of the pulpwood captured in the Statistics Canada survey occurring in Eastern Canada.

It is difficult to develop simple relationships between shipment size for logs and pulpwood and the standard weight and dimension regulations: in some provinces logging trucks operate under special permits; in other provinces there are special rules (exceptions) governing logging trucks; in still other cases logging trucks may operate on private roads (outside the jurisdiction of weight and dimension regulations); and, given the regions many of these trucks operate in, there may be little enforcement of regulations for some of these trucks.

The data from the Prairies confirms some of these possibilities: in 1985, average shipment sizes were 39.7 tonnes (Manitoba), 36.6 tonnes (Saskatchewan),

A) INTRAPROVINCIAL	Atl	Que	Ont	Man	Sask	Alta	BC
1981							
5 - 9.9	0.0	0.0	0.0	-	0.0	0.0	2.0
10 - 19.9	0.6	0.0	0.2	-	100.0	7.3	0.4
20 - 29.9	50.9	0.6	0.0	-	0.0	92.7	82.1
30 - 39.9	48.4	6.1	62.5	-	0.0	0.0	16.9
40 - 49.9	0.1	93.3	37.3	-	0.0	0.0	0.6
1985							
5 - 9.9	0.0	2.2	0.1	0.0	0.0	0.0	0.1
10 - 19.9	0.1	3.2	0.1	0.1	1.5	0.5	0.7
20 - 29.9	58.4	14.0	1.8	4.6	6.0	4.8	38.6
30 - 39.9	39.9	32.3	79.7	44.0	71.3	68.0	59.0
40 - 49.9	1.5	48.3	18.4	51.3	21.2	26.6	1.6
B) EXTRAPROVINCIAL (by origin province)							
1981, 1983, 1985							
5 - 9.9	0.2	1.2	0.0	-	0.0	0.0	3.3
10 - 19.9	1.0	0.1	0.0	-	100.0	11.1	1.3
20 - 29.9	62.2	3.3	30.0	-	0.0	0.0	22.0
30 - 39.9	36.6	16.9	18.8	-	0.0	88.9	73.4
40 - 49.9	0.0	78.5	51.2	-	0.0	0.0	0.0

Table 14 Logs & Pulpwood
(frequency distribution, by TL shipment size)

A) INTRAPROVINCIAL	Atl	Que	Ont	Man	Sask	Alta	BC
1981							
5 - 9.9	0.0	0.1	0.0	0.0	0.0	0.0	2.0
10 - 19.9	2.3	35.4	4.9	100.0	9.7	4.8	11.3
20 - 29.9	80.3	62.0	81.3	0.0	90.0	59.6	2.8
30 - 39.9	17.4	2.1	13.8	0.0	0.2	14.2	24.9
40 - 49.9	0.0	0.3	0.0	0.0	0.0	21.5	59.0
1985							
5 - 9.9	0.0	0.3	0.6	0.0	-	0.0	0.0
10 - 19.9	0.8	23.7	0.1	0.0	-	0.2	3.9
20 - 29.9	55.3	36.5	38.1	100.0	-	67.2	21.6
30 - 39.9	43.6	37.4	61.2	0.0	-	31.0	35.1
40 - 49.9	0.3	2.1	0.1	0.0	-	1.7	39.4

Table 15 Pulpwood Chips
(frequency distribution, by TL shipment size)

and 37.5 tonnes (Alberta). In all three provinces there are significant volumes moving in 40-plus tonne shipments. Payloads of this magnitude cannot be handled under the standard weight and dimension regulations -- particularly considering that these movements are on secondary roads. Maximum GVWs on the most common types of secondary roads are 47.6 tonnes in Manitoba, 49.0 tonnes (summer) and 53.5 tonnes (winter) in Saskatchewan, and 53.5 tonnes in Alberta.

Comparisons among the provinces are complicated by this inability to sort out the role of the non-standard weight and dimension regulations -- where they apply, how much freight they affect. As shown, in British Columbia with its high GVW limits, there are few shipments of logs and pulpwood exceeding 40 tonnes: the average size in British Columbia is around 30 tonnes. In other provinces with similar or even lower GVW limits, shipments tend to be larger. The average size for extra-provincial shipments with an origin in Quebec was 41.5 tonnes in 1985; in Ontario the average for extraprovincial shipments was 36.2 tonnes. Even in Atlantic Canada where the GVW limits are considerably lower than in British Columbia (50 tonnes being the effective limit), shipment sizes are similar to those in British Columbia.

PULPWOOD CHIPS: Pulpwood chips are hauled in specialized vehicles; the latest versions of these, built to the full 23 metres length limit in those provinces allowing this, have 6,066 cubic feet (171.79 cubic metres) of volume. As is apparent from the data shown in Table 15, pulpwood chips do cube out: there is only one significant instance of shipments in excess of 40 tonnes (British Columbia). (The moisture content of the chips can have a significant impact on shipment weight.) Given this tendency to cube-out, the increase in allowable lengths in Eastern Canada in (about) 1983 should have increased shipment weights (as and when new trailers became available). Indeed, there is some evidence to show that shipments in Quebec and Ontario did increase in size in 1983 and thereafter, but the data also shows this same tendency in Atlantic Canada where length limits have not increased to 23 metres. One possibility, accounting for this similarity between Central and Atlantic Canada, is that the vehicles in Atlantic Canada operate under special permit.

GRAVEL: Gravel -- "sand, gravel, and crude stone" -- represents the most important commodity by tonnage handled by the for-hire trucking industry: in 1985 it accounted for 9.3 percent of domestic tonnages. In most provinces (or regions) trailer manufacturers build trailers for gravel haulers that test the upper limits of the allowable GVW.

The large increase in shipment sizes in Atlantic Canada is significant. In Prince Edward Island, there was a jump in 20 tonne or greater shipments between 1981 and 1985 and a doubling of the average weight; in Nova Scotia, there was a large increase between 1983 and 1985 in the number of shipments in the over 30 tonne category (less than 2% in 1981 and 1983 to 31% in 1985); and in New Brunswick, the number of shipments in the over 30 tonne category jumped from 20 percent in the first two years to over 60 percent in 1985. Although the major change in regulations in Atlantic Canada occurred in 1978/79 when the provinces adopted the 9/18/50 kip standard, there were a series of changes occurring through the years 1978 to about 1982 as three of the provinces converted to metric. Presumably these changes plus the length of time required for the 1978/79 major change to fully impact trucking

(particularly important in Prince Edward Island and Nova Scotia) are responsible for these increasingly large gravel shipments.

A) INTRAPROVINCIAL

	Nfld	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC
1981										
5 - 9.9	-	0.0	0.1	0.0	1.1	0.0	1.9	0.0	0.0	0.2
10 - 19.9	-	96.8	10.8	16.6	7.8	2.0	23.3	0.0	7.1	2.6
20 - 29.9	-	3.2	88.6	63.2	64.0	26.0	71.8	39.1	80.5	91.3
30 - 39.9	-	0.0	0.5	20.2	26.8	60.2	0.0	60.9	10.3	4.0
40 - 49.9	-	0.0	0.0	0.0	0.3	11.8	3.0	0.0	2.1	1.9
1985										
5 - 9.9	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.1	0.2
10 - 19.9	0.0	0.0	10.2	19.3	2.0	4.5	1.7	0.1	26.7	3.7
20 - 29.9	53.9	100.0	58.5	20.0	16.9	9.3	26.7	54.3	12.8	18.7
30 - 39.9	46.1	0.0	31.3	60.7	42.3	72.3	71.2	45.5	60.2	61.8
40 - 49.9	0.0	0.0	0.0	0.0	38.3	13.9	0.3	0.1	0.3	15.6

Table 16 Sand, Gravel, and Crude Stone
(frequency distribution, by TL shipment size)

The higher GVWs on New Brunswick's major highways (56.5 tonnes) and the different mix of secondary road GVW limits in comparison to Nova Scotia appear to result in a significantly higher proportion of 30 tonne or greater shipments in New Brunswick. For example, in 1985 61 percent of all gravel in New Brunswick moved in weights over 30 tonnes whereas only 31 percent did so in Nova Scotia.

The data for Quebec, Ontario, and British Columbia show the effect of higher GVW limits. All three provinces have significant amounts of gravel moving in shipments in excess of 40 tonne (in British Columbia, this does not show up until 1985). Average shipment sizes in 1985 are 34.5 tonnes in Quebec, 33.5 tonnes in Ontario, and 31.8 tonnes in British Columbia. The fact that Quebec has a very high proportion of 40 tonne or larger shipments in comparison to the other provinces must be accounted for by more than just regulatory differences (ie, the GVW limit is 57.5 tonnes compared to 63.5 in the other two provinces).

The result of the higher load limits on secondary highways appears to be the explanation for the sharp jump in the number of 30 tonne or greater shipments after 1981 in two of the Prairie provinces (Manitoba and Alberta).

Using Canada-wide revenues per tonne-kilometre for 1985 as a measure of rate levels, shippers save (roughly) 4% as shipments increase in size from the 20 to 29.9 tonne range to the 30 to 39.9 tonne range and roughly the same amount as shipment size increases beyond this to the 40 to 49.9 tonne range. Gravel does not

move long distances, which probably accounts for these relatively low rate differentials.

LUMBER: In 1985 the 4.7 million tonnes hauled by Class I and II carriers represented 3.5 percent of total domestic tonnages.

A) INTRAPROVINCIAL

	Nfld	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC
1981										
5 - 9.9	0.3	-	0.0	2.2	0.7	7.3	9.3	2.9	2.8	1.3
10 - 19.9	6.0	-	27.6	8.9	4.3	12.7	23.7	22.2	12.0	9.5
20 - 29.9	10.8	-	58.3	47.7	68.1	21.1	24.6	38.1	26.9	12.9
30 - 39.9	82.9	-	14.1	41.2	21.9	55.8	42.4	36.8	57.7	45.3
40 - 49.9	0.0	-	0.0	0.0	5.0	3.1	0.0	0.0	0.6	31.0
1985										
5 - 9.9	1.4	-	1.5	4.4	0.7	3.4	6.9	10.1	2.4	1.0
10 - 19.9	2.4	-	1.9	39.5	2.1	10.4	17.7	25.3	28.9	9.3
20 - 29.9	93.8	-	87.5	47.6	32.9	40.8	64.4	55.8	44.4	39.6
30 - 39.9	2.4	-	4.6	8.5	27.4	42.5	0.0	8.8	14.3	31.1
40 - 49.9	0.0	-	4.5	0.0	36.9	3.0	10.9	0.0	10.0	18.9

B) EXTRAPROVINCIAL (by origin province)

1981										
5 - 9.9	-	-	0.0	0.3	0.5	6.4	5.6	0.4	1.0	0.3
10 - 19.9	-	-	13.6	20.0	22.7	41.9	29.0	50.3	18.0	10.9
20 - 29.9	-	-	14.6	36.1	7.5	14.1	15.6	49.3	59.1	44.2
30 - 39.9	-	-	71.8	20.4	32.4	32.6	19.4	0.0	21.9	43.1
40 - 49.9	-	-	0.0	23.2	36.8	5.0	30.5	0.0	0.0	1.6
1985										
5 - 9.9	-	0.0	2.6	1.2	1.0	1.9	0.1	1.3	1.5	0.4
10 - 19.9	-	56.2	23.1	17.1	11.8	19.2	0.5	25.5	15.3	10.4
20 - 29.9	-	43.8	27.3	52.3	51.5	33.8	97.6	53.9	50.3	49.9
30 - 39.9	-	0.0	43.0	20.4	24.9	45.0	1.7	16.6	29.3	34.3
40 - 49.9	-	0.0	3.9	8.9	10.8	0.0	0.0	2.6	3.6	5.1

Table 17 Lumber and Sawn Timber
(frequency distribution, by TL shipment size)

The higher GVW limits in Quebec in comparison to Atlantic Canada and the Prairies are the apparent reason for the much higher proportion of 40 tonne or greater shipments. It is more difficult to explain the much higher incidence of these large shipments in Quebec in comparison to Ontario. Shipments of 40 or more tonnes in Quebec are a challenge given the 57.5 tonne limit on GVW.

In Atlantic Canada the lower GVW limits in comparison to Central Canada can be seen in the relatively small proportion of 40 tonne or greater shipments (the data for 1985 in Nova Scotia is difficult to explain given a 50 tonne GVW limit). What does not appear to be related to weight and dimension regulations is the sharp fluctuations from one year to the next. The following shows this for the region as a whole:

Percent of 30 tonne or greater TL shipments

	intra	extra
1981	43.3	46.6
1983	90.0	70.2
1985	8.3	31.4

This same phenomenon can be seen in the Prairies: the proportion of shipments weighing more than 30 tonnes decreases sharply in 1985. For example, considering intraprovincial shipments, the percentage falls from 59 to 11 percent in Manitoba, from 76 to 9 percent in Saskatchewan and from 67 to 24 percent in Alberta. There appears to be some factor, perhaps economic conditions, other than weight and dimension factor accounting for this change in both Atlantic Canada and the Prairies.

This "other" factor (whatever it is) operates in the face of a clear incentive for shippers to ship in large shipments. Rates in the over 30 tonne category are 23 percent lower than the rates in the 20 to 29.9 tonne weight range. In those provinces where 40 tonne or larger shipments are possible, rates decrease on average another 17 percent.

WOOD PULP: There was little data on wood pulp shipments; total volumes only accounted for 0.2 percent of domestic tonnages for Class I and II for-hire carriers in 1985.

For those provinces where there was sufficient data, the following shows the distribution of TL shipments. The pattern in British Columbia is difficult to relate to regulatory differences. Evidently a large amount of wood pulp in New Brunswick moves on the major highways where GVW limits are 56.5 tonnes (or possibly moves under special permit); the result is that New Brunswick shippers are moving pulp in about the same sized shipments as shippers in Central Canada.

Percent Distribution of TL Tonnage
By Shipment size, 1981, 1983, 1985

	NS	NB	Que	Ont	BC
5 - 5.99	0.0	0.0	2.4	0.5	5.3
10 - 19.99	2.1	1.3	8.8	6.6	33.1
20 - 29.99	96.1	41.3	55.4	57.8	50.1
30 - 39.99	0.2	56.5	33.4	35.1	0.0
40 - 49.99	1.6	1.0	0.0	0.0	11.5

GASOLINE: In 1985, there were almost five million tons of gasoline moved domestically by Class I and II carriers, most of this being intra-provincial hauls. With some qualification (Manitoba in 1985), the higher GVW limits in Quebec, Ontario, and British Columbia are evident in data shown in Table 18.

A) INTRAPROVINCIAL

	Nfld	PEI	NS	NB	Que	Ont	Man	Sask	Alta	BC
1981										
5 - 9.9	0.0	-	6.2	1.8	6.3	4.3	10.9	3.8	2.4	2.9
10 - 19.9	3.3	-	16.9	5.1	15.1	14.2	18.1	14.0	12.0	15.2
20 - 29.9	12.6	-	49.5	18.0	20.3	22.5	43.8	58.6	39.5	40.2
30 - 39.9	84.0	-	27.4	75.1	54.4	47.4	27.1	23.3	45.7	24.8
40 - 49.9	0.0	-	0.0	0.0	3.9	11.6	0.0	0.2	0.5	16.9
1985										
5 - 9.9	3.3	-	1.2	0.9	0.8	2.1	3.5	2.9	2.2	4.8
10 - 19.9	11.1	-	5.8	4.1	3.6	9.0	14.1	10.2	13.1	14.3
20 - 29.9	33.6	-	33.7	13.5	29.8	16.3	24.8	18.7	33.4	29.4
30 - 39.9	52.0	-	59.3	81.5	58.5	50.9	36.3	61.4	43.5	29.2
40 - 49.9	0.0	-	0.0	0.0	7.2	21.6	21.3	6.7	7.9	22.3

B) EXTRAPROVINCIAL (by origin province)

1981										
5 - 9.9	-	-	0.7	4.9	0.0	26.1	16.8	10.8	1.5	0.5
10 - 19.9	-	-	36.7	6.1	1.1	33.2	21.6	13.0	18.5	16.4
20 - 29.9	-	-	4.2	39.3	4.3	16.1	4.3	43.8	59.5	48.7
30 - 39.9	-	-	58.5	49.6	94.5	24.6	57.2	32.4	19.6	22.1
40 - 49.9	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.9	12.3
1985										
5 - 9.9	-	-	1.5	0.0	0.1	0.1	1.5	0.8	3.6	1.1
10 - 19.9	-	-	17.2	1.6	0.4	1.2	12.5	11.3	7.5	13.0
20 - 29.9	-	-	19.7	9.9	4.4	7.5	25.0	15.1	18.2	25.5
30 - 39.9	-	-	61.6	88.5	92.0	78.6	33.3	61.1	65.0	60.1
40 - 49.9	-	-	0.0	0.0	3.2	12.7	27.6	11.6	5.5	0.4

Table 18 Gasoline
(frequency distribution, by TL shipment size)

In comparing the data for Nova Scotia with New Brunswick, there is again evidence of New Brunswick's higher limits on major highways. The difference between New Brunswick and Manitoba (both provinces allow 56.5 tonnes on major highways and have reasonably similar limits on secondary highways) is accounted for by the different types of equipment used (see Part 9). Carriers in New Brunswick use 3-S3 equipment to haul petroleum products whereas carriers in Manitoba use

seven- or eight-axle A-trains. With six axles, the New Brunswick carrier can only register with a GVW of 53.0 tonne (assuming the theoretical maximum front axle) or 48.5 tonne (using a standard 4.5 tonne front axle). At these GVWs, it is not possible to haul 40 tonne shipments of gasoline. In Manitoba, on the other hand, carriers are managing loads of over 40 tonnes.

There is an apparent trend to larger shipments in Ontario -- again unexplainable in terms of any regulatory change (the increase in length limits to 23 metre is actually having a slight tendency to reduce shipment sizes in Ontario -- see Part 9). The average shipment size in Ontario has increased from 26.0 tonnes, to 28.8 tonnes, to 30.5 tonnes over the period, and the proportion of shipments over 30 tonne has grown from 59 percent in 1981 to 73 percent in 1985.

On the Prairies, the impact of the 1982 regulatory change (secondary roads) is again evident:

		Percent of TL tonnages Moving in 30 tonne or greater shipments		
		Man	Sask	Alta
A)	Intraprovincial			
	1981	27.1	23.5	46.2
	1983	44.0	61.3	53.1
	1985	57.6	68.1	51.4
B)	Extraprovincial			
	1981	57.2	32.4	20.5
	1983	67.7	76.7	62.8
	1985	60.9	72.7	70.5

In terms of what shippers pay for moving gasoline in different sized shipments, the rates for shipments over 40 tonnes are (1985) on average 14 percent less than the rates in the 30 to 39.9 tonne range, and the rates for shipments in the 30 to 39.9 tonne range are on average 18 percent less than the rates for 20 to 29.9 tonne shipments.

OTHER COMMODITY GROUPS: A range of other commodity groups were analyzed. Iron and steel products were examined in the hope that this would give some insights into the effect of different regulations on a dense commodity which can be difficult to load (it is sometimes difficult to distribute weight properly over the axles). Cement and concrete products were also examined because it was thought they would show some differences for weigh-out commodities. Tires were examined as an example of cube-out commodities (average TL sizes in 1985 ranged from 5 to 18 tonnes). However, these other groups either showed no good relationships to weight and dimension regulations or else showed minor relationships that have already been shown better by one of the previous groups

7.3 SUMMARY

Large trucks can, and apparently do, haul freight at lower costs than small trucks. Not surprisingly, different or changing weight and dimension regulations which control the size of trucks have an impact on transportation costs. This can be seen most clearly in Saskatchewan where the availability of data has allowed a detailed analysis of several regulatory changes to be made. Since 1974, these change have resulted in an 18 percent decrease in the cost of hauling petroleum products on secondary roads and a 28 decrease on primary roads.

Using Statistics Canada's data, which is more difficult to relate to changes in weight and dimension regulations, it is evident that there have been wide-ranging reductions in transportation costs as a result of different weight and dimension regulations. The data, which has only been used to analyze the change in shipment size and consequent rate reductions (and not the more general change in the level of transportation rates), suggests that there are more 40 tonne or larger shipments in those provinces with high GVW limits (or, in some cases, where special permits control truck size). Rates for these 40 tonne (plus) shipments are anywhere from 4 to 17 percent lower than rates for shipments weighing 30 to 39.9 tonnes. (There are some exceptions to this that are being over-looked.) In other situations, for example grain or gravel on the Prairies, there has been a large increase in the number of shipments in the over 30 tonne category that is directly attributable to changes in the regulations. These shipments are moving at rates of up to 30 percent lower than the rates for shipments in the 20 to 29.9 tonne range. (In both cases, of course, factors other than shipment size have an effect on these rate levels.)

The Statistics Canada data also shows that factors other than weight and dimension regulations are important. That is, while weight and dimension regulations exert a controlling influence on truck size and, hence, shipping costs, they are not the only factors that have to be taken into account when analyzing the subject. Some commodity groups seem to be immune to changes in the regulations or to different regulations in different provinces -- that is, they seem to be immune, given the data analyzed here. In other cases, there are changes in shipment size occurring that are hard to relate to weight and dimension regulations: a trend for some commodity groups to increase in shipment size in provinces such as Ontario where there is no apparent regulatory explanation, or a fluctuating trend for some commodities such as lumber that may be more under the influence of general economic factors than weight and dimension regulations.

8. Regulations and Trucking Part III: Fleet Characteristics

8.1 INTRODUCTION

An important way of understanding the relationship between weight and dimension regulations and trucking is to analyze the characteristics of fleets. Statistics Canada data, the best source of national trucking statistics, contains only broad characteristics about the fleet -- too broad to be of much use in understanding the impact of the regulations.

Each province maintains registration statistics, but there are problems in accessing this data (some cases) and in the accuracy of the information ("multiple" registrations being one of the common problems). Individual provinces conduct road-side surveys on an occasional basis; the problem being that methodologies and scope vary considerably.

For this study, registration files and road-side survey data were gathered from all possible sources. The results are reported in a separate background paper that consists of a series of 72 tables and accompanying text. [18] Little of this information is in an easily digestible format: weight classification categories, vehicle registration categories, road systems surveyed, freight classification systems, and many other things differ considerably from one source to another. Most of the text in the background paper is devoted to the qualifications that attend the use of this data and/or notes on how the data was obtained and massaged into its current form.

In the following section, some of these statistics are presented to give a picture of the trucking fleet. In Section 8.3 a series of observations are made based on the data in the working paper.

8.2 THE DATA

The six provinces for which frequency distributions of trucks by registered weight ("RGVW") are available are shown in Table 19. [19] These are resident truck registrations; that is, they are registered and operating only in the provinces shown or they are registered under a proration agreement among the provinces (CAVR) with a base in the province shown. For those provinces where it was possible to eliminate small trucks (ie, the pickups and vans), a frequency distribution of the fleet by RGVW is also shown. There are qualifications to this information -- for example, the data for New Brunswick excludes trucks registered under CAVR*, the "small" truck category in some provinces is not 3,000 kg as indicated on the Table. For here, the only concessions made to these qualifications is to show the source document weight breaks at the top of the Table.

---

* *Canadian Agreement on Vehicle Registration, an agreement that prorates registration fees on the basis of mileage*

	RGVW (tne)				
Nfld	0 -30	30 -38	38 -45	45 -52.5	52.5 +
N.S.	0 -30	30 -38	38 -45	45 -50	
N.B.	0 -31.5	31.5 -36.5	36.5 -48.5	48.5 -52.5	52.5 +
Que.	0 -30	30 -38	38 -45	45 -54.5	54.5 +
Ont.	0 -30	30 -38	38 -45	45 -54.6	54.6 +
Man.	0 -32	32 -36	36 -48	48 +	
ALL TRUCKS					
Nfld - 1985	89.4	1.4	2.2	6.9	0.1
NS - 1986	98.1	0.4	0.7	0.7	-
NB - 1986	93.1	1.4	3.4	2.1	0.1
Que - 1986	89.7	2.4	2.2	3.7	1.8
Ont - 1985	97.1	0.9	0.7	0.8	0.5
Man - 1982	97.5	0.2	1.9	0.4	-
EXCLUDING PICKUPS AND VANS (RGVW over 3.0 tne)					
NS - 1986	88.3	2.5	4.5	4.6	-
NB - 1986	91.5	1.7	4.2	2.6	0.1
Que - 1986	76.5	5.4	5.0	8.5	4.0
Ont - 1985	84.7	4.6	3.6	4.4	2.8
Man - 1982	90.3	0.8	7.3	1.5	-

Table 19 Distribution of Resident Trucks X RGVW
(% distribution of registrations)

In Table 20, registration statistics are shown for "non-resident" trucks -- that is, trucks domiciled or base-plated in some other province operating through the provinces indicated on the Table. [20]

Three preliminary points can be noted about this data. First, considering the resident truck population, it is clear that most trucks are relatively small (ie, have an RGVW of less than 30 tonnes). Second, comparing the information on resident and non-resident trucks, trucks operating extraprovincially are much larger than those operating intra-provincially, (data in Table 19 contains both intra- and extra-provincially operating trucks; data in Table 20 is only for trucks operating extraprovincially). Third, looking at the changes over time, the information shown in Table 20 indicates that the proportion of large trucks in the fleet is growing. This shows up most clearly in Manitoba where the data extends from 1975/76 (the year after the major change in weight and dimension regulations) to 1983/84: non-resident trucks with registered weights of 45 tonnes or more increased from 2.2 percent of the population to 27.3 percent in this eight-year period.

This same phenomenon -- an increasing proportion of heavy trucks -- is evident in the resident-truck population where data is available over any length of

	Registration year	RGVW (tne) 0 - 30	30 - 38	38 - 45	45 - 54.5	54.5 +
Ont	1974/75	14.2	64.8	10.2	10.8	0.0
	1975/76	15.0	66.3	9.6	9.1	0.0
	1976/77	13.7	66.6	10.1	8.4	1.3
Man	1975/76	11.9	85.6	0.3	2.2	0.0
	1977/78	9.7	84.1	1.3	4.8	0.0
	1978/79	8.9	79.7	0.3	11.2	0.0
	1979/80	8.2	77.8	0.4	13.6	0.0
	1980/81	7.1	75.3	0.8	16.8	0.0
	1982/83	15.0	59.2	2.0	23.2	0.5
	1983/84	12.8	53.8	6.1	26.4	0.9
Sask	1975/76	23.2	72.5	2.3	2.0	0.0
	1980/81	16.6	65.3	0.5	17.6	0.0
	1982/83	21.9	49.9	3.6	24.7	0.0
	1983/84	16.7	47.5	5.1	30.7	0.0
Alta	1982/83	21.9	43.3	10.6	24.2	0.0
	1983/84	20.8	41.0	4.4	33.8	0.0
BC	1975/76	17.6	77.5	3.5	1.4	0.0

Table 20 Distribution of Non-Resident Trucks X RGVW
(% distribution of registrations)

time. (This is not shown in the accompanying tables.) For example, in Nova Scotia, trucks registered at 40 tonnes or more grew from 0.7 to 1.1 percent of the fleet between 1982 and 1986; in Saskatchewan, total resident trucks (excluding farm) registered at more than 38 tonnes grew from 0.0 to 10.9 percent between 1973 and June of 1984.

The data from the road-side surveys is difficult to summarize. In Table 21, the distribution of trucks observed by configuration type is shown; and in Table 22 similar information is shown where it was possible to develop information over time. The "Atlantic" and "WestCan" data are from regional surveys conducted by the provinces and federal government. The surveys from which this information was drawn differ considerably in terms of such things as time of year, class of highway surveyed (primary, secondary), and certain other characteristics. As much as possible, the data shown here is summer (or at least not winter) primary highway observations. Tables 23, 24, and 25 contain data from these same road-side surveys, showing the distribution of the trucks observed by actual weights (GVWs), registered weights (RGVWs), and payloads.

From all five of these Tables, it is apparent that there are regional differences in the use of various configurations and in the size of trucks and their payloads (note

that "doubles" include truck-plus-trailers and A- B- and C-trains; in the case of Alberta, there are even a few triples included). It is also apparent, even though the data is skimpy, that there are changes occurring over time.

In the next Section, a series of observations on this data are made. Some of these can be backed up by the data shown in Tables 19 to 25, but many of them rely on the more detailed information contained in the background paper.

		Straight Trucks	Tractor Semitrailers	Doubles	Source
Nfld	- 1979	38.8	35.3	25.8	[21]
PEI	- 1979	71.3	28.7	0.0	[22]
NS	- 1979	42.9	57.1	0.0	[23]
NB	- 1979	51.1	44.3	4.5	[24]
Ont	- 1983	22.8	66.4	8.6	[25]
Man	- 1978	12.9	80.1	6.5	[26]
Sask	- 1978	18.0	74.9	6.5	[26]
Alta	- 1978	16.2	68.3	15.4	[26]
BC	- 1978	28.4	58.5	12.2	[26]

Table 21 Distribution of Trucks by Configuration
(% distribution of road-side observations)

		Straight Trucks	Tractor Semitrailers	Doubles	Source
Atlantic	- 1976	54.3	43.8	1.6	[27]
	- 1984	52.5	45.0	2.5	[28]
Ont	- 1978	29.5	68.6	1.4	[29]
	- 1983	22.8	66.4	8.6	[30]
WestCan	- 1973	19.0	75.9	4.1	[31]
	- 1974	37.2	58.6	3.3	[32]
	- 1978	16.2	72.0	11.7	[33]

Table 22 Changes in Distribution of Trucks by Configuration
(% distribution of road-side observations)

8.3 OBSERVATIONS

8.3.1 The Large Truck Fleet

To-date, no one has been able to say with much assurance how many large trucks there are in Canada. Statistics Canada's latest figures indicate that as of 1984

		RGVW (tne)				
		0 - 30	30 - 38	38 - 45	45 - 54.5	54.5 +
ALL TRUCKS						
Ont	- 1983	71.7	17.0	2.8	6.1	2.3
WestCan	- 1973	69.8	30.0	0.3	0.0	0.0
	- 1978	61.2	24.8	10.2	3.6	0.1
LOADED TRUCKS						
NB	- 1976	61.8	25.1	9.0	3.6	0.4
	- 1979	55.0	17.9	16.1	9.2	1.8
Ont	- 1975	24.2	42.0	21.9	8.6	3.4
Man	- 1981-82	58.0	38.8	1.4	1.8	*

Table 23 Distribution of GVWs
(% distribution of road-side observations)

there were just over three million trucks and tractors registered in Canada. [34] Of these, information on registered weight is available for 2.6 million. The highest weight category used is 15 tonnes (RGVWs of 33,000 pounds or more), and, according to this source there are 66,816 trucks and tractors in this category.

The information collected here suggests that this figure of 66,816 underestimates the size of the large-truck fleet by a considerable margin. Consider the following figures on the number of resident truck registrations of 30 tonnes or more. (Note: 30 tonne or more; twice the size of the highest category in the Statistics Canada data.) Certain qualifications about these numbers are being overlooked; however, in almost all cases the qualifications are to the effect that one or more truck registration classes have been omitted from the following numbers. If anything (and particularly in the case of New Brunswick), then, these figures underestimate the size of the large truck fleet.

		Trucks with RGVWs over 30 tonnes
Nfld	(1985)	1,174
NS	(1986)	2,338
NB	(1986)	824
Que	(1986)	23,017
Ont	(1985)	24,512
Man	(1982)	3,995
Sask	(1984)	5,741
Alta	(1985)	14,309
TOTAL		75,910

On the basis of these figures, and excluding the numbers from New Brunswick*, it is estimated that there are .00347 large trucks per capita in Canada -- varying from a high of .00609 in Alberta to a low of .00202 in Newfoundland. By extrapolation, the total large truck fleet (over 30 tonne) in Canada is estimated to be 88,000.

8.3.2 Growth Rate of Large Truck Combinations

Heavier trucks are increasing at a faster rate than the lighter trucks. For example, in Newfoundland between 1983 and 1985, the number of resident trucks over 48,500 kg doubled whereas the total fleet increased by 43 percent. In Nova Scotia the number of resident trucks with RGVWs of over 40,000 kg has increased by 102 percent between 1982 and 1986 while the fleet as a whole has increased by only 30 percent.

		RGVW (tne)				
		0 - 30	30 - 38	38 - 45	45 - 54.5	54.5 +
Ont	- 1983	31.9	25.9	7.6	23.5	11.2
WestCan	- 1973	29.7	70.3	0.0	0.0	0.0
	- 1974	44.4	21.7	33.3	0.7	.....
	- 1978	22.1	6.2	61.5	9.5	0.6
Alta	- 1979	49.3	3.7	37.0	10.1	-
	- 1980	42.2	3.1	41.9	12.6	-
	- 1981	34.1	2.6	47.6	15.7	-

Table 24 Distribution of RGVWs
(% distribution of road-side observations)

Further, the number of trucks registered at the highest legal limit (50,000 kg) has increased by 274 percent in this same four-year period. In Saskatchewan, considering all for-hire and private truck combinations (but not farm trucks), the resident fleet as a whole grew by 24.1 percent between 1978 and 1984, whereas the number of trucks in this fleet registered at weights indicating double operations grew by 229.7 percent.

The situation in Ontario deserves note. Between 1983 and 1985, trucks with RGVWs over 50,000 kg increased by 28.4 percent, and those over 60,000 kg increased by 51.5 percent; the fleet as a whole (over 3,000 kg) increased by only 13.1 percent. Unlike the situation in other provinces, there is no recent regulatory change that could account for a shift in the proportion of heavy trucks in the fleet. Barring a recent regulatory explanation, several alternative possibilities suggest themselves: fluctuations in the proportion of heavy trucks with economic cycles (ie, in better times, carriers feel able to spend somewhat more on registration taxes); "spill-over"

* *Resident CAVR registrations are excluded in New Brunswick data.*

		Payload (kg)				
		0 5,000	5,001 -10,000	10,001 -20,000	20,001 -30,5000	30,001 +
ALL TRUCKS (including empty)						
Ont	- 1983	51.4	10.5	18.2	11.0	8.9
WestCan	- 1974	25.0	19.4	30.6	23.7	1.2
	- 1978	31.7	10.3	21.4	33.8	2.7
Man	- 1981-82	51.1	13.4	22.9	12.0	0.7
Alta	- 1979	52.4	.. 28.2 ..		15.2	4.2
	- 1980	52.3	.. 25.5 ..		17.4	4.7
	- 1981	49.3	.. 25.4 ..		19.0	6.3

Table 25 Distribution of Payloads
(% distribution of road-side observations)

effects from other provinces; or, possibly, a general trend to larger trucks independent of any immediate regulatory change (ie, the impact of Ontario's GVW increases back in the 1970s is still working its way through the system).

8.3.3 Extra versus Intraprovincial Trucks

Not unexpectedly, trucks operating extraprovincially are larger than those operating intra-provincially. For example, considering registered weights, in 1986 in Quebec, 45.6 percent of the CAVR-registered trucks had RGVWs over 45,000 kg whereas only 1.2 percent of the non-CAVR trucks had RGVWs this high (3.1 percent if the under 3,000 kg trucks are excluded). Considering payloads, a 1978 survey in Ontario shows that extraprovincial truck trips (loaded and empty) had average payloads of 12,428 kg versus an average of 9,163 kg for intraprovincial trips.

8.3.4 For-hire Trucks

For-hire trucks are registered at higher weights, operate at higher weights, and carry heavier payloads than other trucks. Further, for-hire trucks react to regulatory change faster than other trucks.

On the first point, in Quebec (1986), excluding trucks with RGVWs under 3,000 kg, 12.3 percent of the for-hire trucks had RGVWs in excess of 45,000 kg whereas only 1.4 percent of the private trucks had RGVWs this high. In a 1983 road-side survey in Ontario, 52.4 percent of the for-hire trucks observed had RGVWs above 40,000 kg versus only 33.9 percent of the private trucks. From this same survey, 14.2 percent of the for-hire and only 8.8 percent of the private trucks had GVWs over

40,000 kg; and, from a 1978 survey, the average payload for all (loaded and empty) for-hire trucks was 12,066 kg versus 8,074 kg for private.

On the second point, there is limited evidence. The change in 1974 in both Manitoba and Saskatchewan permitted the use of doubles on the primary highways at the new, higher GVWs. From registration data, it can be shown that the for-hire trucker switched over to these new combinations more quickly than other operators. For example, in Manitoba in 1982, considering the resident fleet of combinations with five or more axles, 34.6 percent of all for-hire trucks were registered at weight levels indicating the use of doubles, whereas only 7.4 percent of the private trucks, 9.1 percent of the farm trucks, and 8.1 percent of the "other" ("T-plates") were so registered. Or, considering the data from Saskatchewan for 1978, and considering the resident fleet of combination trucks, four years after the regulatory change, 71.5 percent of the A/AG (regulated for-hire), 12.9 percent of the C (unregulated for-hire), and 33.8 percent of the D (essentially private) classes were registered with RGVWs suggesting five-axle tractor-semitrailers at the new weight limits. Further, 9.4 percent of the for-hire trucks were registered with even higher RGVWs suggesting doubles, compared to 0.3 percent of the unregulated for-hire and 5.1 percent of the private.

8.3.5 Straight Trucks

The use of straight trucks (as single units) has declined in Western Canada, but apparently not in Eastern Canada. Second, it appears that straight trucks are a more important component of the trucking fleet in Atlantic Canada than in the Prairie provinces. Third, straight trucks are used more on secondary highways (versus primary highways) and more on intraprovincial operations (versus extraprovincial).

The data presented in Table 22 is not the best evidence for the first point: the use of straight trucks does appear to decline a little in Eastern Canada; and the 1974 Western Canada data suggest large fluctuations, instead of smooth trends, in the use of straight trucks. However, the 1974 WestCan data is heavily weighted by observations from secondary roads and therefore distorts the trend in the use of straight trucks. Better data from individual provinces or in some cases from single weigh scales shows the declining use of straight trucks in Western Canada. For example, the most complete and consistent road-side survey data obtained (Alberta 1970 - 1981) suggests that the use of straight trucks (single units) has declined on primary highways from over 40 percent of all truck trips in the early 1970s to under 30 percent of truck trips in the early 1980s. The data from Eastern Canada does not provide as much coverage. In the three Ontario road-side surveys (1971, 1978, 1983) there is no conclusive trend up or down in the use of straight trucks (23.9%, 29.5%, 22.8%); and in the two Atlantic O-D surveys (1976, 1984) there is similarly no conclusive trend (54.3%, 52.5%).

Leaving aside the issue of the growing, declining, or stable use of straight trucks, there is good evidence on the second observation: straight trucks are more important in Atlantic Canada than in the Prairies (see Table 21).

The best evidence for the third observation (straight trucks are used more on secondary roads and on intraprovincial hauls) comes from Manitoba. Straight trucks

accounted for 43.7 percent of all trucks observed at all 13 weigh-scale sites (ie, representing primary/secondary highways and intra/extraprovincial trucking), whereas they only accounted for (roughly) 1 to 4 percent of loaded trucks observed at Emerson (Canada - U.S. crossing point), 4 to 8 percent of all loaded trucks observed at West Hawk (Ontario - Manitoba gateway), and 6 to 22 percent of all loaded trucks observed at Headingley (TransCanada Highway west of Winnipeg).

8.3.6 Truck-Plus-Trailer Configurations

The data on the use of truck-plus-trailer configurations is poor. Nevertheless, there are a few observations.

With one exception, there is no data to suggest that truck-plus-trailer combinations are significant in Atlantic Canada. In Ontario, on the other hand, 4.8 percent of all road-side observations (1983) were truck-plus-trailer configurations (over 80 percent of these had five or more axles). In Western Canada, the available evidence suggests that these configurations are unimportant in Manitoba and Saskatchewan, and relatively more important in Alberta and British Columbia. From the most consistent road-side survey data obtained (Alberta, 1971 - 1981), truck-plus-trailer configurations on primary highways took a one-time sudden leap in popularity in about 1978: prior to 1978, they accounted for 1.2 to 2.6 percent of the trucks observed; after 1978, they have accounted for 4.1 to 5.7 percent of the observations.

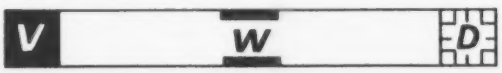
8.3.7 Tractor-Semitrailers

The use of two-axle tractors has declined in Western Canada but not in Eastern Canada. Second, the standard five-axle tractor-semitrailer (3-S2) remains the "work-horse" of the Canadian trucking industry.

On the first observation, good evidence shows that whereas roughly 19 percent of all tractors in Ontario have two axles, in Manitoba and Alberta the use of two-axle tractors has been steadily declining to the point that currently they only account for 3 percent to less than 1 percent (depending on the site) of all tractors. The significance of this observation and its relationship to the regulations is not clear.

The second observation is more significant. That is, while the regulatory changes in Canada over the past 15 years have encouraged the use of large truck combinations, it is easy to lose sight of the fact that the most common configuration in the fleet by a wide margin is the standard five-axle tractor-semitrailer (the "18 wheeler"). This continued domination of the fleet by the 3-S2 may be the result of several trends: the gradual use of the larger combinations as encouraged by the relaxed regulations while at the same time the gradual decrease in the use of two-axle tractors and straight trucks. In other words, as the former 3-S2 operators have "switched-up" to larger equipment, the former 2-S1, 2-S2 and straight truck operators have "switched-up" to 3-S2s.

Whatever the precise reason, consider the evidence: in Atlantic Canada (1984) 3-S2s account for 30.0 percent of all trucks; in Ontario (1983) 3-S2s account for



49.0 percent of all trucks; in Manitoba (1980 - 1981) just under one-half of all truck trip observations at 13 weigh scale sites were 3-S2s; in Saskatchewan (1982) 3-S2s accounted for 41.6 percent of all truck trips; and in Alberta (1981) 3-S2s accounted for 47.4 percent of all trucks.

8.3.8 Trains

The use of double-trailer combinations is far more extensive in Western Canada than in Eastern Canada. For example, on major routes in Western Canada, trains account for as much as 10 to 15 percent of the total number of trucks (as of the early 1980's). While there is less data from Eastern Canada, the latest survey from Ontario (1983) indicates that trains account for less than four percent of the truck traffic on primary highways. (See Part 6 for the reason.)

Three other observations on the use of double-trailer combinations are: trains are used more extensively on primary highways (versus secondary) and on extraprovincial hauls (versus intraprovincial); A-trains out-number B-trains everywhere except in Ontario; and, most of the trains that have appeared on the Prairies since the regulatory changes in 1974 (and later) have been registered at weight levels suggesting that they are being used to haul weigh-out commodities rather than cube-out commodities.

8.3.9 Maximum GVW Limits

The converse of an earlier observation -- that most of the trucks are small (RGVW's of less than 30 tonnes) -- is that the maximum GVW limit is not an issue to the majority of trucks on the road.

For example, in Newfoundland (1985) only 5.2 percent of the resident truck population has RGVWs above 48,500 kg; in Nova Scotia (1986) only 3.5 percent of the resident trucks over 3,000 kg are registered in the highest weight category (50,000 kg); in Quebec (1986), excluding the under 3,000 kg trucks, only 4.0 percent of the resident trucks had RGVWs above 54,500 kg; in Ontario (1983 - 1985) 0.4 to 0.6 percent of the resident trucks with RGVWs higher than 3,000 kg have RGVWs in the highest weight category used in the registration statistics (63,400 + kg) and only five percent of this fleet had RGVWs above 50,000 kg; and in Manitoba (1982) only 0.4 percent of the total resident truck fleet has RGVWs above 48,000 kg, and, only 1.8 percent of the fleet of over 4,000 kg trucks has an RGVW above 40,000 kg.

8.3.10 Inter-jurisdictional Differences

Registration statistics and road-side surveys show that different regulations in different jurisdictions do affect fleet characteristics. For example (see Table 19 or 23), it is clear that there are relatively more heavy trucks in the high-GVW provinces of Quebec and Ontario than in other provinces.

A more important point is that the characteristics of trucks on different traffic lanes are different. The best evidence for this is from Manitoba where data from three weigh scales show the characteristics of trucks operating between three markedly different regulatory regimes: the West Hawk scale (Ontario - Manitoba

traffic), the Headingley scale (Manitoba intraprovincial and Manitoba - Western Canada traffic), and the Emerson scale (Manitoba - U.S. traffic). On the Canada - U.S. route, most of the trucks are 3-S2s (91 - 98% depending on the year); double-trailer combinations cannot be used effectively on this lane (for most traffic) given the 80,000 pound GVW limit on interstate highways. (Doubles are in wide use in the U.S. for the less dense LTL traffic.) On the Ontario - Manitoba route, 3-S2s now only account for about three-quarters of the traffic while trains account for about 16 percent. Further, most of these trains (14:1) are A-trains -- presumably in response to Manitoba's regulations which encourage the use of A-trains. (Ontario road-side data suggest that B-trains are slightly more common than B-trains on the Ontario side of the border.) On the Manitoba - West route the truck characteristics are similar to those seen on the Ontario - Manitoba route only there are somewhat more 3-S2s and straight trucks on account of the greater mix of intraprovincial traffic.

Inter-jurisdictional differences sometimes cause operational inefficiencies for the trucking industry. The data on this is not strong, nevertheless, it can be shown that prior to the 1974 change in the Prairie provinces there were some trucks from Western Canada hauling loads in Ontario that had to be split at the Ontario-Manitoba border. It is assumed that these were all double combinations where a (semi)trailer could be dropped at or near the border crossing for pickup by a tractor bobtailing out from Winnipeg. From 2.6 percent to 3.9 percent, depending on the year, of all trucks base-plated in Western Canada and host-plated in Ontario were engaged in this type of operation (although absolute numbers were small). There is no information on the number of Ontario base-plated trucks (running Ontario -- Western Canada) that were engaged in similar operations. In more recent times, it can be shown that a small number of 3-S3 configurations are operating from Eastern Canada into Manitoba. The extra axle on these configurations is "dead weight" on the Prairies.

8.3.11 Temporal Considerations

The effect of a regulatory change may take many years to fully affect fleet characteristics.

For example, in Nova Scotia the switch to larger trucks made possible by the regulatory change in 1978 is (as of 1986) still occurring. The registration data for CAVR trucks shows that every year more and more of these vehicles are registering at the highest possible weight (50,000 kg) in Nova Scotia: in other words, there was not a sudden, one-time change in the fleet after 1978; rather there has been a continuing trend since that time. In Manitoba, the impact of the 1974 regulatory change, helped by a further change in 1982, is still working its way through the system. In all three Prairie provinces, considering the registration data for non-resident trucks, the trend to double-trailer operations which started in 1974 has taken at least a decade to fully impact the fleet (and, if more recent data were available, may still be having an impact on fleet changes).

8.3.12 Factors Other Than Weight and Dimension Regulations

An observation that is not easy to support with the available data, but which may be of considerable significance in understanding how weight and dimension

regulations affect the fleet, is that there are factors other than the regulations affecting fleet characteristics. The two pieces of evidence to support this observations are: Ontario, where there appears to be changes occurring within the fleet independent of any recent regulatory change (eg, an increase in heavy trucks); and in the Prairies where under relatively similar regulatory regimes, quite different fleets operate.

On the evidence from the Prairies, 51.3 percent of the Saskatchewan fleet of combination vehicles has only four axles, while only 22.5 percent of Manitoba's fleet is in this category. Conversely, 30.9 percent of Manitoba's fleet of combinations has six or more axles while only 8.9 percent of Saskatchewan's does. The importance of farm trucks in Saskatchewan is one of the reasons for this difference but it is not the only one. The whole vehicle registration/economic regulatory system is also a factor. In particular, the unregulated for-hire carriers in Saskatchewan (or exempt-commodity haulers) have a pronounced impact on the characteristics of the total Saskatchewan fleet (they tend to use smaller trucks). But even this does not explain all of the differences. For example, just looking at the absolute number of large combinations (six or more axles), and setting aside these comparison based on relative distributions, in Manitoba as of August 1985 there were 2,170 resident trucks with six or more axles while in Saskatchewan in September 1984 there were only 1,038 such trucks.

8.3.13 The Impact of the Western Highway Strengthening Program

There are four points to note about the impact of the highway strengthening program in Western Canada (resulting in the 1974 regulatory changes) First, the industry's initial response was to re-register the existing 3-S2 equipment at the new axle/GVW limits. For example, in Manitoba, 43.5 percent of the entire resident fleet of combinations had registered at RGVW levels suggesting 3-S2 equipment at primary highway weights within two years of the regulatory change. Obviously, this re-registering of existing equipment is the fastest and easiest response to an increase in load limits.

A second response, and one that took longer to be fully felt (in fact may still be occurring) was that double-trailer combinations came to be the most important component of the trucking fleet. For example, in Manitoba, as of August 1985, 30.9 percent of the total resident fleet of combinations was registered at weight levels indicating double-trailer operations.

Third, the characteristics of the doubles used in the Prairie provinces have changed as a result of the regulatory change. The doubles that existed prior to 1974 were few in number and largely confined to the hauling of light-density general freight; after 1974, the seven and eight-axle doubles used to haul denser commodities replaced these earlier doubles in importance.

Fourth, the segment of the trucking industry that responded the most to the 1974 change on the Prairies was the dry-bulk haulers (eg, grain, potash, fertilizer) using hopper-bottom equipment, much of it double-trailer combinations. Other segments that responded were liquid-bulk-tank (eg, petroleum products), and

dump hauls (eg, gravel), commodities hauled on flat decks (eg, lumber, construction equipment), and livestock hauling.

8.3.14 The Impact of the Atlantic Highway Strengthening Program

The available data on the impact of the federal-provincial highway program in Atlantic Canada, and the resulting 9/18(17)/50 tonne regulatory standard, is sparse. It suggests that the most noticeable impact of the program was the increase in the use of six-axle tractor-semitrailers. For example, considering all of Atlantic Canada, 3-S3s increased from 2.9 percent of all trucks observed in 1976 to 13.2 percent in 1984; further, their share of total tonnes hauled increased from 7.8 percent to 26.7 percent in this same period.

9. Regulations and Trucking Part V: Fleet Selection

9.1 INTRODUCTION

The impact of weight and dimension regulations was examined in Part 6 without considering day-to-day decisions made by operators when selecting equipment. In this Part, an overview of fleet selection is provided for the purpose of putting the regulations into perspective.

Many factors influence choices made with respect to fleet configurations: freight, terminal, route, end-point, vehicle, shipper, industry characteristics, and (obviously) weight and dimension regulations. Information from case studies has been organized into a number of topic to show this.

- SINGLE REGULATORY REGIMES: Two types of trucking show how different regulations affect fleet choice, independent of the impact from other factors.

- MULTIPLE CANADIAN REGULATIONS: The scope is broadened to show what happens when more than one set of regulations influence the choice. Multiple regulations exist within one province, between two or more provinces sharing common weight and dimension regulations, between two or more provinces having quite different regulations, and in cross-Canada trucking situations where all regulations come into play.

- U.S. REGULATIONS: U.S. regulations have a direct and indirect influence on Canadian regulations.

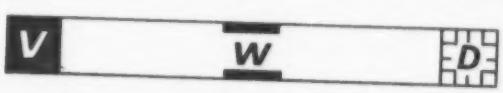
- CHANGES IN REGULATIONS: Some aspects of current fleets cannot be understood without understanding how operators have become used to or are subject to the process of change.

- ENFORCEMENT CONSIDERATIONS: Some aspects of fleet selection are made on the basis of enforcement considerations. Section 9.6 is a series of observations on the issue of enforcement, with no attempt at "conclusions."

- IMPACT OF OTHER FACTORS: Information obtained on other factors (other than weight and dimension regulations) is summarized. This is not the definitive analysis of how these other factors affect fleet choice. Rather, it is only a summary of the views, opinions, and observations collected from the case studies.

9.2 THE IMPACT OF SINGLE REGULATORY REGIMES

Different regulations affect fleet selection, independent of regulatory change over time, independent of conflicting (more than one) regulatory regimes, and



independent of all other factors. As it is impossible to isolate the impact of regulations from all these other factors, the best way of showing these "pure" effects of different regulations is to select a number of situations where trucking is more-or-less similar in all provinces and where vehicles have been designed to operate within the confines of one regulatory regime.

Two types of trucking demonstrate this: petroleum hauling (bulk gasoline and diesel delivered to retail outlets) representing a heavy commodity where weigh-out considerations govern; and LTL freight representing low-density commodities where cube-out considerations govern. Unlike the cube-maximizing and load-maximizing configurations presented in Part 6 (the "on paper" fleet), the trucks described here are actually used by the industry.

9.2.1 Petroleum Haulers

Trucks hauling petroleum products are built for the regulations of one province or, in the case of Atlantic Canada and to some extent the Prairies, one region. The configurations shown in Table 26 are typical of vehicles used in each region -- they are not the only ones.

In Atlantic Canada, tractor semitrailers are used instead of trains because regulations allowing the effective use of trains are more recent than in other parts of the country and are still not as conducive to the operation of doubles. Further, with a GVW of 48.5 to 50.0 tne, a 3-S3 is close to the effective regional maximum allowed (given the 50 tne limit in Nova Scotia). Even in New Brunswick, where 56.5 tne is allowed on major highways, a GVW of 50,000 kg is the effective maximum for petroleum haulers given destinations on secondary roads. (In Newfoundland, the 3-S3 shown in Table 26 is limited to an RGVW of 48.5 tne.)

Although trains are used to distribute petroleum products in Quebec, six-axle tractor semitrailers are more common. There are several varieties; the one shown is distinguished by its wide-spread (1.8 m) tandem-drive axles allowing 19,000 kg, and its tri-axle on the semitrailer with an outer spacing of greater than 4.8 metres allowing a load of 29,000 kg. Triple axles are also used on semitrailers -- with outer spreads of 4.8 metres and loads of 30,000 kg -- but they are used more on highway operations and less in urban deliveries. Trains are not in wide use as the additional GVW available (about 3 tne) is not worth the expense given that at least half of the increased GVW is accounted for by tare weight.

"Typical" is a tricky word to use in the context of Ontario because of the wide variety of possibilities. Nevertheless, the three shown in Table 26 are all common -- or, in the case of the 3-S4, are becoming common. The eight-axle B-train is a relatively old design; newer versions haul up to 62,000 litres of gasoline. The tractor-semitrailer is considerably less expensive than the trains ($15,000) and can carry almost as much payload; however, it is less manoeuverable in some of the smaller retail delivery points.

On the Prairies, trains are used wherever high GVWs are required (see Part 6). A-trains are used for petroleum hauling in Manitoba and Saskatchewan for a number of reasons -- one of them being the influence of U.S. regulations (discussed

below). To some extent, then, the configurations shown in Table 26 are not "pure" examples of the effect of one jurisdiction's regulations. In Manitoba, another reason for choosing A-trains is that since 1982, A-trains have had a payload advantage over B-trains (GVW maximums of 56.5 versus 53.5 tonnes). Alberta, which is not shown, has vehicles similar to those in Saskatchewan.

	Atlantic	Que	Ont (1)	Ont (2)	Ont (3)	Man	Sask	BC
Config.	tr-semi 3-S3	tr-semi 3-S3	B-train 3-S3-S2	B-train 3-S2-S2	tr-semi 3-S4	A-train 3-S2-2	A-train 3-S2-2	B-train 3-S3-S2
GVW	50,000	54,350.	63,500	62,1000	61,230	55,200	53,500	63,500
Tare								
- tractor	8,618	8,618	8,810	8,810	9,000			9,072
- trailers	8,437	8,437	11,100	10,150	9,600			11,453
- total	17,055	17,055	19,910	18,960	18,600	18,144	18,144	20,525
Payload								
- kg	32,945	37,295	43,590	43,140	42,630	37,056	35,356	42,975
- litre	44,823	50,741 - 51,000	59,306	58,694	58,000	50,416 - 50,901	48,103 - 48,539	58,100 - 58,469
Dimensions								
- height (m)			3.58	3.60	3.60			3.58
- length (m)		19.94	21.46	21.46				21.58
Axle Loads (kg)								
- #1	6,000	6,350	7,005	7,500	6,500	5,000	4,500	5,500
- #2-#3	17,000	19,000	17,055	18,500	18,310	16,000	15,750	17,000
- #4					9,155			7,000
- #4-#5				19,100		16,000	15,750	
- #4-#6	27,000	29,000	20,860					
- #5					9,155			
- #5-#6								17,000
- #6						9,100	8,750	
- #6-#7				17,000	18,310			
- #7						9,100	8,750	
- #7-#8			18,580					17,000

Table 26 Typical Petroleum Tank Trucks

In British Columbia, eight-axle and some seven-axle B-trains are used to haul petroleum products. Doubles have to be used to register a vehicle at the highest GVW (see Part 6). The 3-S3-S2 shown is not the same as in Ontario. Because of British Columbia's axle spacing and self-steering requirements (for three-axle groups), the B-train in British Columbia has a tri-axle with a self-steering belly axle on the lead semitrailer. The Ontario B-train uses a triple axle.

Although the effect of changing regulations, different regulations, and other factors are all evident in the choice of these tank trucks, they are normalized to some extent by concentrating on a type of trucking common in each region. Imperfections in this process of normalization aside, different regulations result in distinct vehicle types.

9.2.2 LTL General Freight Carriers

LTL carriers select equipment designed to maximize cube. Given that, with minor qualifications, maximum cube is a function of available trailer length, there are five regulatory elements controlling the available trailer length: limits on the length of individual vehicles (eg, 45', 48', 50' + semitrailers); length limits on vehicle combinations; limits on the kingpin-to-rear; limits on the rear-of-the-cab-to-rear (see Vehicle Weight and Dimension Regulations in Canada); and, restrictions on load-carrying devices (dromes, or container platforms) on tractors (probably only an issue in British Columbia). In Table 27, available trailer lengths (in feet) are shown for each region under three headings:

	Typical Trailer Lengths	Possible Trailer Lengths	Special Permit Vehicles	
Atlantic	48'	54' 60'	X	-2 X 27' pups & 12' dromes with 48' semi's possible
Quebec	48'- 56'	66'4"	96'	-18'4" dromes plus 48' semi's possible -96' turnpike doubles by special permit
Ontario	48'- 56'	66'4"	X	-18'4" dromes plus 48' semi's now operating
Prairies	54'- 55'	56' 57'	81'- 96'	-2 X 28' now difficult, but will become standard -long combinations by special permit -9' dromes with 48' semi's possible
BC	54'- 55'	56' 57'	X	-2 X 28' now practical -9' dromes with 48' semi's possible

Table 27 LTL General Freight: Available Trailer Length

- TYPICAL TRAILER LENGTHS: From Ontario east, the 48-foot semitrailer is or is becoming the standard for many LTL carriers. Some of the larger national LTL carriers use double 27-foot and sometimes double 28-foot pups in Quebec and Ontario. Doubles are not common in Atlantic Canada because of the difficulty of configuring them within the prevailing 21 metre length restriction and the ban on A-trains under the standard regulations. In Western Canada, double 27-foot and sometimes 27- plus 28-foot combinations are common.

- POSSIBLE TRAILER LENGTHS: Without attempting to be precise about the dividing line between "typical" and "possible", 54 feet through the use of double 27-foot pups is theoretically possible in Atlantic Canada, given the use of short wheelbase tractors (roughly less than 3.48 m) and 12-foot dromes are also possible where tractor-semitrailers are allowed an overall length of 21 metres. In Ontario and possibly Quebec, there now are a few 48-foot semitrailers and 18'4" dromes operating. On the Prairies, although 56 feet is possible ("on paper") through the use of double 28-foot pups, there are not many (and perhaps no) true double 28-foot combination operating.* This will change rapidly now that three of the provinces have changed or are about to change the kingpin-to-rear limit. It is also possible to use 48-foot semitrailers with 9-feet dromes in Western Canada, but this is not a practical combination for most LTL operations.

- SPECIAL PERMIT VEHICLES: In the last column, the available trailer length from special permit vehicles is shown where these vehicles are allowed to operate (on designated roads and under a series of conditions).

9.3 The Impact of Multiple Canadian Regulations

Different regulations affect fleet selection; (a) within one jurisdiction where such things as primary/secondary road regulations or winter/summer regulations result in vehicles operating under two or more regulatory regimes; (b) within several jurisdictions having similar regulations where there are minor differences among the regulatory regimes (eg, Atlantic Canada, or the Prairie provinces); (c) within several jurisdictions where there are significant differences among the regulations (eg, Atlantic-Quebec, or Ontario-Manitoba); and (d) within many jurisdictions where all regulatory differences have an influence on the choices (eg, cross-Canada).

When confronted with multiple regulations, a carrier has two choices: the "least-common-denominator" approach (ie, the most constraining element in one set of regulations governs the vehicle specifications), or the "vehicle-that-can-be-modified" approach. Modifications can be made with various devices on the vehicle: sliding fifth wheels, moveable kingpins, liftable axles, sliding axles, extendable tongues; or, through various operational procedures: loading, bobtailing, etc. In either case, trucking costs increase -- higher capital costs, higher tare weights, empty miles, higher loading costs.

9.3.1 Different Regulations Within One Jurisdiction

Within a province, different regulations may exist for different roads, different seasons, different vehicle types, or different commodities. These multi-layered regulations affect fleet selection.

---

* *One carrier interviewed uses double 28's with tapered (bull-nosed) pups, giving an effective length of roughly 27'. Another carrier had a fleet of B-trains with a total length of 55.5' -- these configurations exceeded the 16.75 m limit by 6".*

For example, considering road class, one carrier in Nova Scotia selects 3-S2s rather than the more productive 3-S3 because the regulations only allow 17,000 kilograms on any axle group on secondary roads. Three axles on the semitrailer are superfluous. As another example, carriers in the Prairie provinces opted for A-trains in the 1970s instead of B-trains because A-trains can be easily dis-assembled to conventional 3-S2s: when doubles first became widely feasible (1974/75), the differences in allowable GVWs and axle loads for primary and secondary roads meant that carriers wanted equipment that could be converted easily and used on either road system. Now that the distinction between primary and secondary roads has become less important, at least one carrier is switching back to B-trains.

Considering seasonal differences in regulations, a carrier in New Brunswick only requires 3-S2 equipment for some of its hauls (given the payload available) but selects 3-S3 equipment because of the spring weight restrictions. That is, since the restrictions limit axle loads to a percentage of the normal load, X% of a three-axle load is better than X% of a tandem-axle load in the spring. The carrier operates for most of the year, then, with more costly and heavier trucks than are necessary. A Manitoba-based carrier uses seven-axle A-trains (3-S2-2) rather than the more productive eight-axle variety (3-S2-3) because, among other things, it can get the maximum GVW (56,500 kg) on the seven-axle combination for several months of the year given the ten percent winter premiums. In other words, the extra cost of switching to eight-axle equipment is not worth it given that the carrier can already get the highest GVW available for part of the year.

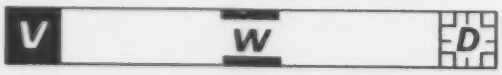
9.3.2 Different Regulations Among Similar Jurisdictions

Within Atlantic Canada and within the Prairie provinces there are broad similarities in the regulations. Nevertheless, there are small differences within these two regions that affect fleet selection.

For example, a carrier hauling salt in New Brunswick uses 3-S2s rather than the more productive 3-S3 because the salt originates in Nova Scotia on secondary roads where the maximum axle load for any group is 17,000 kg. As another example, Manitoba's encouragement of A-trains over B-trains (higher GVWs) has been a factor in the use of A-trains across all three Prairie provinces. One Saskatchewan carrier has purchased eight-axle A-trains in the hope of obtaining special permits to operate them in Saskatchewan at the Manitoba GVW limits -- the eighth axle gives the carrier no advantage in Saskatchewan, in fact there is a payload penalty because of the extra tare weight.

9.3.3 Different Regulations Between Dissimilar Regions

There are significant regulatory differences between Atlantic Canada, Quebec, Ontario, the Prairies, and British Columbia (see Part 5). Considering the most notable "regulatory border" between Ontario and Manitoba, most carriers opt for combinations which exhibit the least common denominator of the two sets of regulations. Typically, this is a seven-axle A-train operating at 53,500 kg. For a thousand miles of this haul, that vehicle is operating beside configurations such as eight-axle trains with GVWs of 63,500 kg and payloads up to 25 percent higher (in the extreme, 43 tonnes versus 34 to 35 tonnes).



1) Leave Southern Ontario

	tractor	semitrailer	semitrailer		
	o	0--0	0--0--0	0--0	
loads	7.0	19.1	21.4	16.0	= 63.5

2) West Hawk

	tractor	semitrailer		drop 2nd semitrailer	
	o	0--0	0--0--0	|	0--0
loads	7.0	19.1	11.4	10.0	16.0

3) Into Winnipeg with First Semitrailer

	tractor	semitrailer		
	o	0--0	0--0--0	
spacing		| --5.0--	|	
loads	5.5	16.0	16.0	= 37.5

4) Into Winnipeg with Second Semitrailer

	tractor	semitrailer		
	o	0--0	0--0	
spacing		| --5.0--	|	
loads	5.5	15.5	14.0	= 35.0

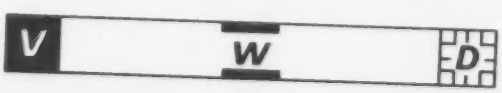
5) Re-combines as Western B-train

	tractor	semitrailer	semitrailer		
	o	0--0	0--0--0	0--0	
spacing		| --5.0--	| |	--5.0--|	
loads	5.5	16.0	16.0	16.0	= 53.5

Table 28 Seven-axle B-train, Ontario - Western Canada

One carrier on this Ontario-to-Western Canada lane has opted for the vehicle-that-can-be-modified approach: it is shown in Table 28. The carrier hauls steel to Western Canada and uses a number of combinations designed to work at maximum GVWs in both Ontario and the Prairies. The vehicle shown in Table 28 (only one of several operated) has been built with modifications that added $15,000 to the price.

At point (1) the unit is configured as a typical Ontario eight-axle B-train with a GVW of 63.5 tonnes. The particular axle spreads and spacings are not important, other than to note that the distance between axles #3-#4 and #6-#7 can be as



little as 3.6 metres. At point (2), the B-train has reached the Manitoba border (West Hawk) and has been dis-assembled. From West Hawk (3), the tractor hauls the first semitrailer into Winnipeg; but, to do this in accord with Manitoba's regulations, two aspects of the configuration have to be changed. First, the kingpin is moved forward 0.76 metres which has the effect of taking load off the steering axle (5.5 tonne is the maximum load for this configuration in Manitoba); second, the first axle on the semitrailer is raised as its use is superfluous in Manitoba and as a spacing of 5.0 metres has to be achieved between the two axle groups (for the load shown). Once in Winnipeg, the driver drops some load and bobtails back to West Hawk to pick up the second semitrailer. To haul this second semitrailer back into Winnipeg (4), the semitrailer tandems slide back to again achieve a spacing of 5.0 metres between the two axle groups. Back in Winnipeg, more load is dropped and the two semitrailers are re-combined into a Western Canada B-train. The combination, with one kingpin moved forward, one axle raised, and one tandem axle moved backwards is now ready to haul into Saskatchewan and Alberta at a GVW of 53.5 tonnes.

Other areas where significantly different regulations affect trucking include carriers operating on the Atlantic Canada-to-Central Canada lane (a variety of allowed axle loads and spacing requirements), carriers in Atlantic Canada who purchase trailers from other regions only to find that the axle spacings do not quite conform to the rigid requirements of the region, and carriers from the Prairies who operate east or west and who sometimes try wide-spread tandems for the extra payload allowed, usually on a small portion of their operations (ie, the spread tandems used give no payload advantage on the Prairies.)

9.3.4 Different Regulations Across Canada

Some types of trucking involve selecting fleets that can operate across Canada. Two examples are the household goods carriers and the LTL general freight carriers.

Household goods carriers, requiring cube more than weight, have opted for the least-common-denominator approach to the regulations, typically using 3-S2 equipment with 48-foot semitrailers. These are used as they fit within the 20 metre length restriction for tractor-semitrailers in the most limiting provinces. Typically, these combinations provide a load of 113 cubic metres. However, these same configurations with drome boxes (5.5 m) are legal in two provinces at 23 metres and provide up to 142 cubic metres in payload -- a 25 percent increase.

LTL carriers select fleets for a number of reasons, but available cube is one of the more important given the density of the freight. While there are a range of possible configurations (Table 27), the larger national LTL carriers have tended to use the double 27-foot pups as these meet the most limiting aspect of the various regulations (the kingpin limit). Some refer to these configurations as double 28-foot pups, but the available length is the same as in a double 27-foot combination.

9.4 The Impact of U.S. Regulations

U.S. regulations have an impact on Canadian fleets. This occurs in two ways: the direct effect where a Canadian vehicle operates in the U.S. and therefore has to comply with U.S. regulations; and the indirect effect where U.S. regulations affect

vehicles operating only in Canada or where U.S. regulations affect Canadian regulations.

As an example of the direct effect, carriers with U.S. operations are choosing the traditional 3-S2 because of the U.S. 80,000 pound GVW limit on the interstate system. Configurations with more axles would gain no payload. These vehicles tend be less efficient than competing configurations when operating on the north side of the border (eg, when completing the New Brunswick-to-Ontario leg of a N.B.-Ont.-U.S.-N.B. movement). As another example, carriers in Western Canada chose A-trains over B-trains in part because of the use of the "B Formula" by a number of states in setting allowable GVWs off the interstate system and because of the 80,000 lb limit on the interstate. The reason is twofold: an A-train with an extendable tongue can be stretched to comply with the requirements of Bridge Formula B; and an A-train can be easily disassembled to 3-S2 configuration.

There are several examples of the indirect effect of U.S. regulations. The use of 96" running gear and in some cases 96" wide trailers is probably the best known: for some years, even though Canadian regulations permitted 2.6 metres (102"), much of the running gear and some of the trailer frames were built to the U.S. standard 96". This is no longer an issue since the U.S. adopted the 102" standard in 1982. A second example of the indirect effect of U.S. regulations concerns the use of 48-foot semitrailers. Canadian provinces adopted this 48-foot limit as a result of changes in U.S. regulations. A third example of the indirect effect of U.S. regulations concerns one Canadian LTL carrier. Apparently, because double 28-foot pups have become standard south of the border, the price of used 27-foot pups is low. As a result, this carrier has just purchased a large number of used American 27-foot pups. Here, then, is a situation where a change in U.S. regulations affects vehicle prices which in turn affects the type of configurations used in Canada.

9.5 The Impact of Changes in Regulations

There are several aspects to changing regulations: (a) the time it takes for regulatory change to work its way through the system; (b) the process of change creating an "anticipatory" mentality; (c) the scale of the regulatory change -- that is, the degree by which regulations have to change before truck operators decide to react; and (d) inefficiencies resulting from the process of change -- that is, instances of where the process of change itself leads to inefficiencies even where the change allows more efficient vehicles.

9.5.1 The Rate of Adjustment

The time between a regulatory change and actual changes in fleets is hard to predict as a great number of variables are involved. Several examples illustrate how long this lag may be.

A Western Canada-to-Ontario LTL carrier chose double 26-foot configurations in 1974 in response to the Western Canada Highway Strengthening Program -- these could be operated within the 65-foot length limit. While the carrier has since moved on to other configurations, both in response to changes in the length limits on the

Prairies and in response to Ontario's move to 23 metres in 1982, the point is that today -- 13 years after the regulatory change -- these double 26-foot pups are still operating.

Milk haulers (Atlantic Canada and Ontario) noted that their trailers have a life cycle of 10 to 12 years, with one re-building of the trailer occurring half-way through. As these are expensive (stainless steel) tanks, these carriers would not modify their operations as a result of regulatory change until the existing trailers were retired.

9.5.2 Expectations

Some of the choices made with respect to fleets are a function of anticipated changes in the regulations. Particularly on the Prairies, the number and frequency of significant changes since 1974 has established an "anticipatory" mentality. This has been reinforced by the publicity given to the RTAC/CCMTA study; carriers believe that the provinces are committed to introducing change as a result of this research. For example, one Manitoba carrier is now buying all of its new equipment with spread tandems (1.8 m on trailers and 1.5 on tractors) in the expectation that Manitoba and Saskatchewan will adopt the practice common in other provinces of allowing higher axle loads for wider spreads. Another Manitoba carrier is now using 1.5 metre tandems on all of its equipment under the same expectation. A Saskatchewan carrier's latest purchase of two-axle pup trailers includes tanks on the pups of sufficient size to allow for three-axle loads, if and when the conversion to three axle is made possible by changes in the regulations.

9.5.3 The Scale of Change

Changes in regulations do not result in immediate, wide-spread changes in fleets. For example, several carriers in Atlantic Canada indicated that the difference between 45-foot and 48-foot semitrailers was not significant enough to make them scrap their old equipment. Their attitude was that they would use their existing 45-foot semitrailers until age dictated the need for replacement.

One tank truck operator in Manitoba considered the increase in allowable GVWs from 50 to 56.5 tonnes significant enough to re-do all of its pup trailers, increasing their capacity by 4,500 litres. With the change, the carrier could now haul at 54.8 tonnes. Interestingly, the carrier did not feel the addition of an eighth axle, to bring the GVW up to 56.5 tonnes, was worth the cost: the gain of roughly 1.7 tonnes to GVW would be off-set by about one tonne more in tare weight and additional capital and operating costs.

In a complex case -- it involves shippers' preference for 45-foot trailer loads and U.S. operations where 45-foot semitrailers weigh out -- a carrier from Western Canada is still using 3-S2s with 45-foot semitrailers and GVWs of 36 to 37 tonnes. The carrier would consider switching to larger units if the GVW limit in Manitoba were raised to 63.5 tonnes (Ontario's limit), but at the current 56.6 tonnes that carrier has not seen fit to alter its basic fleet configuration.

One carrier used to break its doubles at the Ontario-Manitoba border when the difference in GVWs was 63.5 versus 50 tonnes. Now that the difference is 63.5/56.5, it operates straight through to Southern Ontario at the Manitoba GVW limit. This carrier finds that a difference of seven tonnes in GVW is not worth the additional costs of running a tractor out from Winnipeg to pick up a pup trailer at the border.

9.5.4 Inefficiencies Resulting From the Process of Change

Most regulatory changes have allowed the use of more productive trucks. However, as one carrier noted, one effect of the constant series of changes that have occurred on the Prairies since 1974 is that at any given time only 20 percent of its fleet is optimal (presumably this being the most recent additions).

A tank operator in Saskatchewan used to purchase its tanks so that they would weigh-out on gasoline. However, a series of adjustments in the allowable limits meant that it was always facing a situation where some of the tanks were too small. The company now buys larger tanks than necessary, in anticipation of regulatory change, with the result that under the current regulations it is hauling more tare weight than necessary and less payload than possible.

An Alberta trailer manufacturer points out that propane and anhydrous tanks were traditionally built with 90" diameters -- this being considered an optimal design. The increase in allowable GVWs, but the presence of the 16.75 kingpin-to-rear limit, meant the abandonment of this design. To take advantage of the available GVW, more cube is required than can be accommodated in a 90" diameter tank within the 16.75 limit (ie, the tank is too short). The current tanks suffer from a higher (than optimal) tare weight because of this problem.

9.6 The Impact of Regulations Given Enforcement Considerations

The relationship between weight and dimension regulations and trucking cannot be understood without considering enforcement practices. For example, some claim that Ontario would not now have such a variety of combinations (ie, axle types and/or arrangements) if the axle-load provisions of the regulations had been enforced when the bridge formula was first introduced (early 1970s). Ontario's concentration on gross weight after the adoption of the bridge formula stimulated the development and extensive use of a wide variety of axle arrangements; some configurations still have trouble with the Bridge Formula as any afternoon spent at a weigh scale demonstrates.

As another example, there are difficulties in designing and loading hopper-bottom B-trains in Western Canada: it is hard to ensure that loads are distributed in a manner ensuring compliance with axle-load limits on the centre tandems. This problem has discouraged the use of B-train hopper-bottom units in Manitoba and Saskatchewan where axle loads are relatively strictly enforced. B-train hopper-bottom units are more common in Alberta; one of the reasons being the (reportedly) more lenient approach taken on axle-load enforcement.

Several carriers from Atlantic Canada indicated they had problems meeting the 21 metres length limit when owner-operators with long wheel-base tractors hooked up to 48-foot semitrailers. Some indicated this was not an important issue as enforcement of the length limit in these situations was "soft." Another carrier from Ontario is now operating C-trains on its Western Canada hauls as "it was told" that this was the only way to get a double through Saskatchewan (untrue). Several carriers report uneven treatment when it comes to enforcing the 16.75 metre kingpin limit: one was allowed to operate for some time with configurations that exceed the limit by 15 centimetres. In some instances, enforcement agencies have decided that a container is an "indivisible load" -- the key to acquiring an overload permit. Most freight in a van, however, is clearly divisible and, hence, is obliged to move at the ordinary axle/GVW limits. A carrier from Atlantic Canada purchased a trailer from Quebec with axle spacings that did not comply with local regulations: the authorities have turned a "blind eye" to the situation. Many carriers feel that there is a segment of the trucking industry that regularly and consciously operates outside the legal weight and dimension limits: this makes it difficult for the legitimate operator to compete.

Finally, one last enforcement topic raised by many people concerns axle loads: "the highway scales are inconsistent", "loads shift", "moisture contents vary from load to load", "the shippers control the load", etc. The issue as to whether or not there are problems with the enforcement agencies' handling of axle loads cannot be fully dealt with. There are, however, three points to note.

First, the problem with axle overloads is affecting the choices made with respect to fleets, as is evident by such things as (a) the use sliding fifth wheels to control the load distribution between steering and drive axles, (b) the case of one Ontario carrier who switched from using super single tires (apparently the carrier was overloaded on some axles for some trips, so it switched back to dual tires), (c) those carriers who are using more axles or more-closely spaced axles than are really necessary in some situations because they may occasionally have a problem with axle overloads, or (d) the previously-mentioned case of the choice between B-train or A-train dry-bulk hopper-bottoms on the Prairies (B-trains are avoided if there is strict enforcement of axle loads).

Second, this problem with axle overloads suggest that some regulatory systems are better than others in the sense that the simpler the approach taken in the regulations the fewer problems.*

Third, the problem with axle overloads is having an impact on trucking costs in that concerns about axle overloads affect equipment costs (some cases), operating costs (some cases), or competitive conditions (ie, the situation of the carrier who tries to comply with the regulations versus the operators who do not).

---

* *One province appears to have deliberately adopted this "simple-is-better" approach. In Quebec, gravel (and other similar) trucks are exempted from the spread requirements of tandem and triple axles.*

9.7 The Impact of Other Factors on Fleet Selection

As noted at the beginning of Part 9, there are a range of factors other than weight and dimension regulations affecting the choices made for particular configurations. The following are observations developed on the subject as a result of interviews across the country.

FREIGHT CHARACTERISTICS: Some of these characteristics, such as dry-bulk versus liquid versus general freight, have an obvious effect on the trailer types: dumps, hoppers, tanks, flatdecks, vans, etc. Other characteristics are a less obvious. For example, the standard eight-foot lengths used in some industries (construction) may result in one carrier selecting 48-foot semitrailers instead of double 27- or 28-foot pups even though there is an apparent loss of space. However, when loading eight-foot sections more space can be lost in a double 27- or 28-foot combination than in a 48-foot one. This is similar to the issue of palletized freight where sometimes the new 48-foot semitrailers are not preferred over the "old" 45-foot ones as the extra three feet is useless.

Other similar factors affecting fleet choice are: carriers hauling refrigerated commodities who do not want to use doubles because of the cost and trouble of maintaining two reefer units; carriers who feel that B-trains are not suitable for LTL operations; and TL carriers who haul certain types of freight (30-foot pipes) not suitable for double-trailer operations.

TERMINAL CHARACTERISTICS: Carriers are constrained in the equipment they can use by the characteristics of terminals. Some beer carriers cannot use doubles given the layout of many retail outlets. Other carriers find they cannot use dromes unless they redesign their terminals (allowing the tractors to back up to docks with the tandem-drive axles underneath the loading floor). Some carriers report that they have not switched to doubles because of resistance from their customers: doubles increase the number of doors required at terminals.

ROUTE CHARACTERISTICS: Route aspects such as the length of the haul, the type of highway, the geographic characteristics (rural, inter-city, mountainous, urban) and the nature of the haul (peddle, point-to-point) affect fleet selection. For example, on shorter runs larger configurations may not be as efficient as smaller ones: a 3-S2 might be used rather than a 3-S3, or a tractor-semitrailer configuration might be preferred over a double given the extra time it takes to handle doubles.

A tank truck operator, using several types of configurations including large B-trains, uses 3-S3s on deliveries where mountainous roads are involved. Given available tractors, the carrier can complete the route with the 3-S3 so much faster in comparison to the B-train that it compensates for the smaller payload (47,000 versus 58,000 litres). A milk hauler in Ontario selects A-trains or truck-plus-trailer configurations but not B-trains because of the nature of its routes. On the pickups (farms), the carrier needs relatively small tank trucks and/or tractor-semitrailers; on the linehaul, the carrier needs large units; and on the deliveries to dairies the carrier sometimes needs a unit that can drop a pup at one dairy while taking another load to another dairy. B-trains are not suitable for this constant process of assembling and dis-assembling, nor are they suitable where the lead trailer has to be used as a single unit.

END-POINT CHARACTERISTICS: Sometimes the choice of equipment and/or axle types is constrained by the characteristics of the end-point. For example, milk haulers might use straight trucks in some cases because of the size of farmers' yards. They also use 1.2 metre tandems, even where higher loads are possible with wider tandems, because of the damage wide-spread tandems do in close-manoeuvering situations.

A brick hauler in Ontario uses a truck-plus-trailer configuration because of the manoeuverability of such a unit at construction sites. The trailer can be easily unhooked, allowing the truck to enter the site to make a delivery. After transferring the load from the trailer to the truck, the truck re-enters the construction site to complete the delivery. In British Columbia, this same rationale is used by gravel haulers who also select truck-plus-trailer configurations because of the way they can transfer a load from a trailer to a truck at a construction site where the two-vehicle combination cannot be used in combination.

Several carriers noted that the amount of turning space at terminals was preventing them from switching to doubles. In fact, some report that shippers have strongly discouraged the carrier's use of doubles because of the difficulty of handling them within confined areas.

VEHICLE CHARACTERISTICS: The following comments show how vehicle characteristics interact with the regulations to affect fleet choice.

Forty-eight Foot Trailers: One carrier purchased 48-foot semitrailers even though its freight weighed-out on 45-foot trailers: the difference in purchase price between a 45-foot and a 48-foot is very small and the carrier believes the 48-foot semitrailers will have a higher re-sale value a few years down the road. A householdgoods carrier, using specialized trailers, noted that the difference in price between a 45-foot and a 48-foot semitrailer was about $300.

Axle Spreads: There is a trade-off between the higher loads allowed in some provinces with wide-spread tandems and the extra costs involved. For example, a 1.8 metre tandem costs a few hundred dollars more than the 1.2 metre, it adds to tare weight, and it increases tire wear. One carrier tried 1.8 metre tandems, but has since abandoned them because of the problems with "ploughing" and steering. A carrier from Atlantic Canada noted that evenly spread three-axle groups (8' plus 8') are preferred in bulk commodity movements where the distribution of the load over the three axles is critical; the uneven spread tri-axle (6' plus 10') is preferred where turning ability is required.

Four Axle versus Three-axle Trailers: An Ontario carrier uses eight-axle configurations (truck-plus-trailer) because he feels the four-axle trailer is safer (sways less, more brakes) and handles easier (backing up) than the three-axle trailers. The carrier gains no payload by using eight-axle equipment rather than seven-axle; in fact, there is a slight tare-weight disadvantage. In a different regulatory environment, a trailer manufacturer on the Prairies actually refuses to fill requests for four-axle trailers (on the Prairies, short of a special permit, these could only be hauled behind a three-axle truck). The manufacturer's rationale is that 3-4 units are not "appropriate" -- presumably because of the weight of the towed unit in relation to the weight of the truck.

A- versus B-trains: Many opinions are held on the relative advantages of A- or B-trains. (Too few C-trains were seen to be included in this discussion.) Ignoring those that arise because of terminal, route, end-point, shipper, or industry characteristics, and ignoring those where one type was selected because of the impact of regulations (Manitoba favoring A-trains, the influence of U.S. regulations, enforcement considerations, changes over time), the following are situations where various characteristics influence the choices: (a) the relative stability of B-trains; (b) B-trains have an advantage in that the division of the load between the lead and second pup is not as critical as on A-trains (apparently because of the weight transfer with B-trains); (c) the heavier tare weight of B-trains, according to some, is a disadvantage in comparison with the A-train (there were contrary opinions); and (d) the difficulty of mixing lead with rear pups in B-trains.

Short Pups: Some feel that pup trailers of 20-foot or less are not stable; some loads, such as lumber, bounce around on short pups; and, short pups have a tendency to roll.

Doubles versus Tractor-Semitrailers: Some advantages and/or disadvantages of doubles have been noted with respect to freight characteristics (TL freight, refrigerated freight), terminal characteristics, and route characteristics (short hauls, mountainous terrain). In addition to these considerations, there are others relating to opinions and/or perceptions about combinations. One carrier noted that a double set costs twice as much as a single: that is, for a gain of roughly 12.5 percent in cube (54/48) -- and this ignores any cube lost because of loading problems in doubles -- equipment costs double. Several carriers mentioned that the apparent cube advantage of a double (say 2 X 27') over a single (48') is not as great as the figures 54:48 suggest: in many applications the double 27-foot pups will lose a certain amount of loading space (2' - 3' per pup), reducing the available cube to not much more than that available in a 48-foot semitrailer. One carrier from British Columbia noted that if and when the current prohibition on three-axle groups on 48-foot semitrailers is lifted they would consider reducing the number of doubles they operate (a 3-S3 can potentially, but rarely practically, register at 52,200 kg versus a double's 63,500 kg).

Truck-plus-Trailers: The major disadvantage of this combination, according to some, is the down time associated with periodic maintenance requirements. Unlike a tractor-semitrailer, when a truck is down, the freight-carrying vehicle is also down.

Long-Wheelbase Tractors: One carrier suggested that the preference for long-wheelbase tractors was connected with (a) lower maintenance cost, (b) greater stability, (c) better aerodynamics, and (d) driver comfort ("better ride").

SHIPPER CHARACTERISTICS: Little is known about the importance of shipper characteristics; however, in at least one case a for-hire carrier is still using 45-foot semitrailers because its customers "think" in terms of shipping in quantities that just fill such a trailer.

INDUSTRY CHARACTERISTICS: In some instances industry characteristics play a role in determining aspects of fleets. A private carrier ships mainly on 3-S2s even

though it could increase payloads considerably by switching to 3-S3s. The reason is the use of owner-operators and the method used to pay them: there is no incentive in this payment schedule that encourages owner-operators to switch to three-axle semitrailers. Presumably this can happen where owner-operators are (a) paid so much a load irrespective of the size, or (b) paid so much a mile, or (c) paid on a weight basis where the scale is such that the higher revenues earned on larger loads do not off-set the extra costs.

Several people indicated that some of the configurations being used were justified, among other things, because the "drivers were used to or preferred that type of equipment." Examples of the type of equipment being operated under this justification included the use of long wheelbase tractors, the use of conventional tractors instead of COE's, the use of 3-S2s instead of 3-S3s, etc.

One person was of the view that one of the reasons explaining the relative popularity of B-trains in Alberta in comparison to Saskatchewan (Saskatchewan and Alberta have similar regulations) is the promotion on the part of trailer manufacturers. In other words, some manufacturers in Alberta promoted B-trains heavily after they first appeared.

There are several reasons why the household goods moving industry has not switched to doubles. One of these concerns the manner in which the industry is organized. Briefly, because owner-operators handle most of the interprovincial shipments and because these individuals are responsible for the load, it is not feasible to use a combination (such as a double) where some of the shipments would be out of the control of the driver (ie, in the case of a double, the driver would have to disassemble his vehicle prior to entering residential areas and leave it with some other agency for unloading or furtherance.)

10. OBSERVATIONS

The object of this research was to understand the inter-relationship between weight and dimension regulations and trucking. Having examined this relationship, there are a number of observations that summarize the findings.

10.1 Diversity in Current Regulations

There is a great deal of diversity in the current regulations. This is more than the "simple" differences shown on Table 1. That is, while different dimensions, axle loads, and GVW limits are a critical component of regulatory diversity, they pale in comparisons to other aspects of the regulations -- for example, the different methods used to spread allowable loads along the length of a vehicle.

Having noted the diversity, another point has to be raised: how much trucking is affected by the diversity in the regulations? Leaving aside the vast majority of the total three million trucks in Canada (vans, pickups, and small straight trucks for the most part) there are only 88,000 (or so) large truck combinations. But, even within this fleet, given the available activity statistics, a great number of trucks operate in fairly local environments (within one regulatory regime) or operate

"below" the regulatory limits (ie, are not cube or load-maximizing). These trucks, while certainly controlled by aspects of the regulations, are not particularly affected by the diversity.

The importance of the largest trucks in the fleet operating inter-provincially cannot be minimized. There is, however, a point to keep in mind when considering regulatory change: the great majority of trucks on the road are only affected in a small way (if at all) by the diversity in weight and dimension regulations. Within the large truck (over 30 tonne) fleet, the largest single component remains the standard five-axle tractor-semitrailer which does not maximize load under any regulatory regime in Canada and which only maximizes cube in rare circumstances (ie, with a 48-foot trailer and a drome).

10.2 Impact of Changing Regulations

Over the past 15 years there have been a number of research projects initiated that attempted to forecast the impact of changing weight and dimension regulations. This research has had difficulty in making these forecasts or in understanding the process linking weight and dimension regulations with fleet adjustments.

There is still a lot to learn about this process, but some evidence is available by considering two regions. Actually, regulations have changed in all provinces over the past decade or so, but given the available data and the size of the regulatory change, the best place to look for this evidence is in either Atlantic Canada or the Prairies.

ATLANTIC CANADA: Using Statistics Canada's data on for-hire trucking, the evidence on the effect of the 1978/79 change in regulations (the 9/18/50 tonne "standard") is imperfect -- that is, some commodities show an impact, some do not. One reason is that a good proportion of Atlantic Canada had axle and GVW limits as high (or higher) than the standard prior to 1978/79. These problems aside, the evidence supports the following contention: as a result of the adoption of the 1978/79 standard weight and dimension regulations, particularly in Nova Scotia, and as a result of the subsequent minor changes, some commodities have shifted to larger shipment sizes. This is best shown in gravel where the proportion of shipments weighing 30 tonne or more increases throughout the region and in particular within Nova Scotia -- rising from less than one percent of total tonnage in Nova Scotia in 1981 to 31 percent by 1985. Another commodity where the result of this regulatory change can be seen is gasoline: again concentrating on Nova Scotia, the proportion of TL tonnage moving in shipments weighing 30 tonnes or more increased from 27 percent in 1981 to 59 percent in 1985.

Considering other data sources, the evidence on the impact of change in Atlantic Canada is sparse. At best it can be said that there has been an increase in the use of six-axle tractor-semitrailers. In 1976 these configurations accounted for three percent of all truck trips and in 1984 this had risen to 13 percent. At the same time, their share of total tonnes hauled increased from eight percent to 27 percent.

PRAIRIES: Between 1974 and 1987, trucking on the Prairies has changed from a situation where the large truck fleet consisted mainly of five-axle tractor semi-

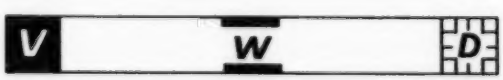
trailers capable of hauling 18 to 21 tonnes of freight to a situation where most of the large volumes of freight are now handled by seven or eight-axle double-trailer combinations with payloads of up to 36 tonnes. In addition, there are now a whole range of even larger (by cube or weight) trucks operating under special permit.

The clearest evidence of the impact of changing regulations on the Prairies comes from Saskatchewan (because of the quality of the available data). As a result of the 1974 and 1982 changes in regulations, rates for hauling petroleum products have dropped by 18 percent on secondary roads and 26 percent on primary roads. (This does not take into account some of the special permit tankers now operating in Saskatchewan.)

The Statistics Canada data on for-hire truckers is best suited to showing the effect of the 1982 regulatory change, particularly the increase on secondary highways. These changes had a marked impact on shippers of commodities with an origin or destination off the primary highways who had not been able to take advantage of the 1974 changes. In particular, prior to 1982 only a small amount of grain moved in shipments exceeding 30 tonnes. By 1985, most grain moved by for-hire trucks was moving in shipments of 30 or more tonnes. In Saskatchewan, for example, less than one percent of intraprovincial grain shipments weighed 30 tonnes or more in 1981; by 1985, 67 percent weighed over 30 tonnes. Using 1985 Canada-wide average rate information (as a proxy) shippers moving grain in these sizes are paying roughly 28 percent less than shippers moving grain in 20 to 30 tonne shipments. The movement of gasoline also demonstrates this point: for example, in 1981 only 24 percent of the intraprovincial TL tonnages in Saskatchewan moved in shipments exceeding 30 tonnes; by 1985, 68 percent of the tonnages did so.

The data on fleets also indicates the impact of the 1974 and 1982 changes. The industry's first response (1974/75) was to re-register existing five-axle equipment at the new primary highway GVW limits for an immediate 2.7 tonne payload gain. A second response that took longer and may still be occurring was the switch to double-trailer combinations: as of 1985, 31 percent of resident Manitoba combinations were registered at weights suggesting double-trailer operations.

GENERAL: In addition to the evidence on the impact of changing regulations from these two regions, there are several more general observations. First, the largest trucks in the Canadian truck fleet are growing at a significantly faster rate than the fleet as a whole. Second, it appears that for-hire operators react to regulatory change faster than other operators. Third, there is some evidence to suggest that the impact of regulatory change on fleets takes years, sometimes many years to fully work its way through the system. Unfortunately, this evidence does not seem to point to any "simple" rules of thumb (eg, half the trucks in five years will . .); rather, it almost seems to suggest that each trucking operation has to be considered on a case-by-case basis (the nature of equipment, the type of freight, the magnitude of the regulatory change, etc.) Finally, there is some evidence (it is not conclusive) to suggest that not all commodities and/or trucking operators respond to regulatory change (at least over the time period for which there is data). In some ways this last observation is not particularly surprising (two and three-axle straight trucks are still very common in most provinces); but it has to be stated as there has been a tendency in previous research to multiple total freight volumes by some imagined numbers to assess the impact of change.



10.3 Impact of Different Regulations

The impact of different regulatory regimes is closely linked to the previous observations on the impact of changing regulations. That is, the impact of two sets of regulations in two jurisdictions can be similar to two sets of regulations in one jurisdiction at two points in time. There are some fairly obvious implications of different regulations. As shown in Part 9, different regulations result in quite different truck types (eg, the petroleum tankers shown in Table 26); or, as shown in Part 8, there is some relationship between a province's regulations and the size of the trucks registered and/or observed on the road. In addition to these expected impacts of different regulations, there are some other points to note.

FLEET CHARACTERISTICS: There are many aspects of fleets that vary according to the regulatory regimes under which they operate. In Part 9 the choices of individual operators were described. There are several broad observations on these choices.

First, it is clear that the different regulatory regimes in Eastern and Western Canada have had a substantial impact on fleets in terms of the use of double-trailer combinations. In Western Canada, doubles have to be used for maximum payloads; in Eastern Canada maximum loads (cube and weight) can be achieved for many commodities on single semitrailers.

Second, there are clear instances of where the existence of different regulatory regimes have led to higher costs for truckers. Equipment designed for the regulations of one province having a lower re-sale value or truckers operating sub-optimal equipment in terms of load or cube-maximization are the obvious examples of this. Other examples include the evidence of operating inefficiencies created at the Ontario-Manitoba border -- the most dramatic instance being the steel hauler who has spent $15,000 on a vehicle and who runs two extra trips between West Hawk and Winnipeg in an attempt to accommodate several sets of regulations.

Third, it is clear that the "multi-layered" nature of different regulations is more complex than most realize. That is, it is not just that Quebec and New Brunswick have different allowed loads for tandem axles that is important. Rather, in terms of understanding trucks and trucking (and ignoring here pavements, bridges, and traffic), it is important to understand that trucks may have to operate within multiple layers of regulations within one province (season, road, commodity, etc.), and sometimes within multiple regulations of several provinces, and even sometimes within multiple layers of regulations within some provinces and some states.

COMMODITY FLOWS: The Statistics Canada data on for-hire trucking shows some of the results of different regulatory regimes, **not**, it must be emphasized, for all commodities. For example, consistent with both the relatively lower GVW limits, the shorter length limits, and the shorter period of time since the major change in regulations (1978/79), there are fewer large shipments in Atlantic Canada than in Central Canada and, in some cases, than in Western Canada. For example, log and pulpwood shipments are on average roughly 10 tonnes lighter in Atlantic Canada in comparison to Quebec or Ontario; average gravel shipments in Atlantic Canada are

roughly 25 tonnes versus 33 to 35 tonnes in Central Canada; and there is no gasoline moving in Atlantic Canada in 40 or more tonne shipments whereas over 20 percent of the intraprovincial movements in Central Canada and British Columbia weigh over 40 tonnes.

In Central Canada and British Columbia, the higher GVW limits are evident in the fact that for most commodities there is a greater proportion of 40 tonne or more shipments in these provinces than anywhere else. One of the best examples of this is in the case of intraprovincial gravel movements: in 1985 35 percent of the TL gravel in Quebec, 14 percent in Ontario, and 16 percent in British Columbia moved in shipments exceeding 40 tonnes. In the rest of the country there was virtually no gravel moving in shipment sizes this large.

TRUCKING COSTS: Different regulations control truck size. The cost of any particular trucking operation can vary considerably depending on a long list of factors (factor prices, utilization, etc.). However, if all of these other factors are held relatively constant, the available data suggests that a doubling of truck size (weight or cube) comes close to halving trucking costs.

TRANSPORTATION COSTS: There is no simple way of saying that the regulations of one province have X% impact on transportation costs in comparison to the regulations of some other province. There are too many variables about which not enough is known. Nevertheless, the for-hire shipment data shows that there are some differences for some commodity groups. In those provinces (the high-GVW provinces discussed above) where the regulations allow shipments of 40 tonnes or more, transportation costs are anywhere from four percent to 17 percent (depending on the commodity) lower than would otherwise be the case.

10.4 The Role of Weight and Dimension Regulations

In understanding the relationship between weight and dimension regulations and trucking one of the key things uncovered during the course of this research is that there is not a simple one-to-one relationship between regulations (or changes in regulations) and trucking (or changes in trucking). This is apparent whether the data being considered is registration data, road-side survey data, Statistics Canada's for-hire shipment data, or the data collected from the interviews. Examples include:

- Considering the Statistics Canada data on some commodities, there is no obvious relationship between the size of shipment and the axle or GVW limits in a province, nor is there any apparent trend over time that can be related to regulatory change.

- Considering other Statistics Canada data on commodities (eg, lumber) there appear to be marked swings in shipment size (hence transportation costs) totally independent of weight and dimension regulations (possibly related to economic conditions).

- Considering road-side survey data, there has been a reasonably clear trend away from the use of straight trucks in Western Canada whereas there has been no such trend in Eastern Canada. There is no known regulatory explanation for this difference between East and West.

- Considering vehicle registration data, the figures suggest that there are differences in the fleets of the Prairie provinces that cannot be totally explained by weight and dimension regulations. For example, Manitoba has twice as many large (over six-axle) combinations than Saskatchewan (with the exception of the higher GVW limit on primary highways, the two provinces have roughly similar regulations and populations).

- Considering the material gathered from the individual operators (Part 9), it is clear that is a long list of factors working in conjunction with weight and dimension regulations influencing choices made with respect to fleets (the carriers who still use 45-foot trailers because their customers "think" in terms of the load a 45-foot trailer carries; the carrier who has not switched to 3-S3s because of the way his owner-operators are paid, etc.).

10.5 Unresolved Issues

There are a series of issues that either require more research or remain unresolved. Without attempting to draw up an exhaustive list, there are two areas that deserve special mention.

First, in terms of understanding the regulations and trucking, there are two areas where not enough is known. These topics were not perceived to be as important at the beginning of this research as they in fact turned out to be. The first is special permitting. While not much can be said about this in quantitative terms, there is no question that special permits control a large amount of trucking activity in Canada and that special permitting is growing in importance. The whole concept of special permitting large trucks as opposed to enshrining weight and/or dimensional elements in standard regulations is a process that might well have been considered as an alternative some years ago. The second area is enforcement. Again hard statistics are lacking, but again there is no doubt that there are some aspects of enforcement requiring greater examination. The amount of trucking that avoids enforcement efforts and the resulting impact on all other "legitimate" truckers, and the enforceability of different types of regulations are the two aspects that stand out most clearly.

Second, in terms of the broader understanding of the transportation system, a point made in Part 2 requires reiteration: while more and more factors are being examined lately in terms of the effort to understand and/or improve weight and dimension regulations, it nevertheless remains true that there still are some missing pieces and that a full "system view" has not been developed. Road-user taxes are a good example of one of the missing pieces: what should an eight-axle A-train registered at 63.5 tonnes pay for using the road in relation to a seven-axle B-train registered at 53.5 tonnes? A second good example of a missing piece and a good example of where the system view has not been developed is the inter-modal aspects of weight and dimension regulations: if it turns out that an efficient use of the public road network, built largely for the use of automobiles and still to-day having vast stretches that are under-utilized in terms of capacity, is to allow more and more large trucks, what happens if the consequences are that the rail system becomes more expensive for fewer and fewer shippers?

10.6 The Process of Regulatory Change

An odd thing to contemplate when considering weight and dimension regulations is the process of change. In the early 1970s, there was relative uniformity among Canadian jurisdictions: Ontario was the only province that had any significant aspect of its regulations different from the 18/32/74 kip standard for single/tandem/GVW limits and 65 feet length limits (it allowed triple axles and GVWs of 116 kips).

Whatever the precise reasons for the series of changes that have been made since the early 1970s, and clearly the federal-provincial agreements in Atlantic Canada and the Prairies have been at the centre of a lot of this, there has been an element of "catch-up." But "catch-up" can turn, perhaps inadvertantly, to "leap-frog." The best modern-day example of this is the 16.75 metre kingpin limit. It was itself established by the Prairie provinces to put an end to operators with short and long wheelbase tractors leap-frogging over each other to see how much trailer length they could cram into the overall length limits. But once the kingpin limit was established, rather than ending the leap-frogging, it started its own peculiar life. Ontario, followed by Quebec, picked this limit up in 1982 (or thereabouts) and wrote it in a different manner -- 16.75 metres could now be exceeded in some circumstances. Back to Western Canada where, in an attempt to make regulations more uniform with Central Canada and the U.S. where double 28-foot pups are becoming a standard configuration, one province has ceased to enforce the limit, one is in the process of changing it, and another province also in the process of change is currently special permitting combinations with an 18 metre kingpin limit. (Are double 29 or 30-foot pups next?)

It is difficult to understand where the "technical" factors come into this process. Aside from this, there is a more subtle point about the process of change itself. In the attempt to become more uniform, Canadian jurisdictions have gone from a relatively uniform system in 1970 to a very divers system to-day. It is not yet known whether the results of the RTAC/CCMTA study will give the provinces a "fix" on some these issues such that this process of change alters its form.

10.7 The Inadequacy of Basic Research

When a province decides to change some aspect of its weight and dimension regulations, or more often when a province decides to spend some money on its highways in conjunction with a regulatory change, it creates a need for research on the impact on trucking. Fair enough; it is difficult to find fault with the origins of this "project-orientated" research. Unfortunately, as these occasions turn out to be the only time anyone investigates the relationship between weight and dimension regulations and trucking, certain deficiencies are evident in the results. Simple assumptions about the nature of these relationships have to be made, little material is available to tell the investigators what truck fleets look like in the jurisdiction they are concerned with let alone in other jurisdictions with different regulations, data sources are discovered to be inadequate and more assumptions are made, and the full complexity of regulatory change is not understood. The research becomes a quest for a number, perhaps any number, to justify the exercise.

There is a lack of good basic research and good basic data (such as the number of large trucks) on trucking in Canada, and this becomes particularly clear every time someone initiates a project-orientated "impact" study.

10.8 The Reason for Regulatory Conflict

In the attempt to understand the relationship between the regulations and trucking, the single most important factor that had to be grasped in this research was the nature of regulatory conflict: that is, the diversity in the current regulatory milieu and its impact on trucking. This raises the question as to why regulatory conflict has arisen. There are a number of factors. [35]

First, there is divided jurisdictional responsibility: the provinces establish the regulations. Second, there are divided technical responsibilities. That is, and as outlined in Part 2, there are at least 15 areas where detailed information on technical relationships are required: some of this is engineering information (pavements, bridges, vehicle design), some of this is economic (road-user taxes, trucking markets and efficiency), and some of this is more in the realm of policy inputs (enforceability of regulations, inter-modal consequences of different regulations). The linkages between these various areas has been weak and, even after all of the research over the past three years, is still not complete.

Third, there are different transportation problems and/or needs in different regions of the country. Only one province regulates power-to-weight ratios (British Columbia has mountains); Ontario special permits all of its automobile carriers (the auto industry is important to Ontario); the Prairies have lower axle-load limits (the regions has difficult soil conditions); Atlantic Canada has lower over-all length limits (its road geometry is more restricted); and various provinces use exemptions and or special permits for forest industries or farm products.

Fourth, the regulations themselves have become far more fragmented over the years. This is, in part, the "multi-layered" aspect of regulations discussed in Part 9. While some of these layers no doubt make sense from the highway engineer's perspective -- different regulations for different roads, different seasons, exceptions for some vehicles, special permits, etc. -- no one yet knows the full impact of these multiple layers on trucking. The resulting trucks operating through this fragmented maze are often sub-optimal in terms of any particular regulatory regime.

Fifth, there are varying philosophical approaches evident in the current mix of regulations. In Atlantic Canada, the approach is to specify limits in terms of very specific (and limited) combination types; Ontario's approach is exactly the opposite; Quebec and Western Canada's approach is somewhere in the middle.

Sixth, as with any regulatory endeavour, a portion of the current regulatory conflict has to be blamed on ordinary human failings. Some provinces rounded their regulations differently when they converted to metric; in some regions provinces have had meetings to agree on certain common points only to write them up differently when they returned home; and, some provinces have copied aspects of other province's regulations but have inadvertantly changed them in the process.

Seventh (and finally) there is the de jure/de facto differences that add to the regulatory conflict. Much of this is related to enforcement efforts. The point is, the impact of the regulations cannot be fully understood considering only the de jure aspects. The system has to be delivered "on the road" and the differences in this delivery system in each of the provinces has led to more conflict.

10.9 The Need for Uniformity [36]

Most of the research into weight and dimension regulations over the past few years has been initiated on the understanding that the goal was to rationalize the regulatory setting. "Rationalization" to almost everyone has meant more uniform regulations. But, rationalizing regulations requires more than uniformity; indeed, the additional requirements might be of much greater consequence to achieving rationalization than uniformity ever could be. For example, undertaking regulatory change which leads to improved truck productivity or safety at the expense of uniformity may well be considered as a move toward rationalization is some circumstances. On the other hand, pursuing uniformity at the expense of other things may well increase irrationality. There are several reasons for this, not the least of which is that no one knows today what technical fix should be used in setting the regulations. ("Technical fix" is more than just the factors being considered in the RTAC/CCMTA study; it includes at least all of the 15 factors discussed in Part 2.)

Other important factors which argue against a policy of unabashed uniformity include: it would constrain technological and operational innovation, an important and expanding aspect of Canadian trucking; such a policy would be insensitive to ever-changing transportation problems and needs of different regions of the country; and, it ignores the fact that a lot of trucking is still very much a local undertaking possibly best regulated by local regulations.

This does not mean that rationalizing Canadian regulations will not require striving for certain types of uniformity - it will. But over and above effecting appropriate levels and types of uniformity, rationalizing regulations will require other things, including: (a) establishing technical soundness in those regulations from the system perspective; (b) ensuring that the regulations are flexible enough to accommodate and even promote technological innovation by the trucking industry and all of the technical disciplines involved in trucking; and (c) making the regulations and the regulatory system understandable and enforceable. These types of developments will reduce regulatory conflict and promote rationalization - sometimes hand-in-hand with greater uniformity, other times not.

REFERENCES

1. Nix, F.P., Clayton, A.M., Bisson, B.G., 1985, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #1, Description and Analysis of Vehicle Weight and Dimension Regulations"*, Transportation Development Centre, Montreal.

2. Nix, F.P., 1985, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #2, Previous Research"*, Transportation Development Centre, Montreal.

3. Nix, F.P., Clayton, A.M., 1985, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #3, Availability of Provincial Data"*, Transportation Development Centre, Montreal.

4. Nix, F.P., 1986, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #4, Analysis of Registration and Road-Side Survey Data"*, Transportation Development Centre, Montreal.

5. Sparks, G.A., 1986, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #5, Productivity/Operational Implications of Vehicle Weight and Dimension Regulations"*, Transportation Development Centre, Montreal.

6. Nix, F.P., Clayton, A.M., Bisson, B.G., Sparks, G.A., 1986, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #6, Case Histories"*, Transportation Development Centre, Montreal.

7. Nix, F.P., Sparks, G.A., 1987, *"Study of Vehicle Weight and Dimension Regulations and Canada's Trucking Industry, Background Paper #7, Impact on Shippers"*, Transportation Development Centre, Montreal.

8. International Symposium on Heavy Vehicle Weights and Dimensions, June 8-13, 1986, Kelowna, British Columbia, sponsored by the RTAC Council on Highway and Transportation Research and Development and the Research and Development Directorate of Transport Canada.

9. Statistics Canada, Service Bulletin: *Surface and Marine Transport, 3,2, catalogue 50-002, Jan. 1987*. The latest figures on municipal roads are for fiscal 1980/81: Roads and Transportation Association of Canada, 1983, *Highway Statistics: 1980-1981*, Ottawa. The data given on municipal road lengths is 661,343 km, however, this is a soft estimate given the problems with defining certain concepts and the problem of information reporting from various agencies.

10. Canada: Transport Canada, 1982, *Transport Costs and Revenues in Canada 1969 - 1979*, Strategic Policy Directorate, TP 3737, Ottawa.

11. Statistics Canada, *op. cit.*, *(Service Bulletin, January 1987)* reports actual federal/provincial expenditures for fiscal 1985 at $4.9 billion. *RTAC NEWS*, 12,2, Aug. 1986, reports the two senior levels of government were planning to spend $4.4 billion on roads for the most recent fiscal year. Municipal expenditures are probably in the range of $1 to $2 billion (Transport Canada, *op. cit.*, 1982).

12. Statistics Canada, *Trucking in Canada - 1984*, catalogue 53-222, and Statistics Canada, *Railway Transport in Canada*, 1984. The components of this estimated $22 billion in are as follows: for-hire freight and household goods carriers ($6.8); very small for-hire carriers with annual revenues of less than $100,000 ($1.2); specialized carriers such as couriers ($1.0); private carriers with 15 or more vehicles ($4.1); private non-freight truckers such as those operating utility trucks ($0.7); private freight carriers with 5 - 14 vehicles ($8.0), and small private carriers with fewer than five vehicles ($unknown).

13. Statistics Canada, *op. cit.*, *Trucking in Canada - 1984*.

14. The full review of previous research is contained in a Background Paper (Nix, *op. cit.*, *Background Paper #2*). In the text, use is made of a subsequent refinement of the author's thoughts on the subject which appears in: Nix, F.P., Clayton, A.M., 1986, *"Assessing the Impact of Weight and Dimension Regulations: Methodological Considerations"*, International Symposium of Heavy Vehicle Weights and Dimensions, Kelowna.

15. U.S. Federal Highway Administration, 1985, *The Feasibility of a Nationwide Network for Longer Combination Vehicles*, report of the Secretary of Transportation to the United States Congress pursuant to Sections 138 and 415 Surface Transportation Assistance Act of 1982, Washington, D.C.

16. The material in this section is developed from *Background Paper #6*; however, an earlier version appears in: Clayton, A., Sparks, G., Mak, R., 1983, *"Truck Industry Technological Response to the Western Canada Highway Strengthening Program"*, Roads and Transportation Association of Canada, annual conference, Edmonton.

17. The main published results of the survey are reported in the *For-hire Trucking Survey*, Catalogue 53,224 for the years prior to 1984. In 1984, Statistics Canada began a new publication, *Trucking in Canada*, Catalogue 53-222 which contains among other things the results of the *For-hire Trucking Survey*. All the data used in this research originated from the master computer files of the survey.

18. Nix, *op. cit.*, *Background Paper #4*.

19. Sources for the registration data shown are as follows:
    Newfoundland - Registrar of Motor Vehicles
    Nova Scotia - Registry of Motor Vehicles
    New Brunswick - Registrar of Motor Vehicles (the data was received after Background Paper #4 had been prepared)

Quebec - Régie de l'assurance automobile du Québec
Ontario - "S04" reports from the Ministry of Transportation Communications
Manitoba - Manitoba Department of Highways and Transportation, 1983, *Manitoba Motor Carrier Industry: System Characteristics*, for the Task Force Review of Motor Carrier Regulations in Manitoba, Winnipeg.

20. Most of the data shown has been developed from: Clayton, A.M., Mak, R., 1985, *Selected Canadian Vehicle Registration Statistics for Large Trucks: Prairie Provinces, British Columbia and Ontario, 1970 - 1985*, The Transportation Group, Department of Civil Engineering, University of Manitoba, Winnipeg.

21. Newfoundland Department of Transportation and Communications, 1980, *Canada/Newfoundland Primary Highway Strengthening/Improvement Program - An Engineering and Economic Evaluation*, St John's.

22. Prince Edward Island Department of Highways and Public Works, 1981, *Primary Highway Strengthening/Improvement Program -- Engineering and Economic Evaluation*, Charlottetown.

23. Nova Scotia Department of Transportation, 1981, *Canada/Nova Scotia Primary Highway Strengthening/Improvement Agreement: Engineering and Economic Evaluation*, Halifax.

24. Fiander-Good Associates Ltd., 1981, *Canada/New Brunswick Primary Highway Strengthening/Improvement Agreement: An Engineering and Economic Evaluation*, New Brunswick Department of Transportation, Fredericton.

25. Parera, M.H., Corupe, E.G., 1984, *Ontario Commercial Vehicle Survey - 1983*, Ontario Ministry of Transportation and Communications, Report TDF-84-05, Toronto.

26. McNeal, Hildebrand and Associates Ltd., 1978, *Western Canada Truck Origin-Destination Survey 1978*, two volumes, Transport Canada, Ottawa.

27. New Brunswick Department of Transportation, 1976, *Atlantic Provinces 1976 Truck Origin-Destination Survey*, two volumes, Fredericton.

28. Fiander-Good Associates Ltd., 1985, *Final Report: The Atlantic Provinces Primary Highway Strengthening/Improvement Program Motor Carrier Benefit Study*, prepared for New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland, Transport Canada, Fredericton.

29. Ontario Ministry of Transportation and Communications, 1980, *Ontario Commercial Truck Survey 1978*, Economic Policy Office, Downsview.

30. Parera & Corupe, *op. cit.*

31. Trimac Consulting Services Ltd., 1973, *Western Canada Truck Origin-Destination Survey*, Transport Canada, Ottawa.

32. McNeal, Hildebrand and Associates Ltd., *op. cit.*

33. Trimac Consulting Services Ltd., 1975, *The Western Canada Truck Traffic Survey -- 1974*, draft, Transport Canada, Ottawa.

34. Statistics Canada, *op. cit., Trucking in Canada - 1984*, pp. 197 - 200.

35. This section owes much to: Clayton, A.M., Nix, F.P., 1987, *"Regulatory Conflicts Among Jurisdictions"*, presentation, *TRB*, Washington, D.C.

36. This section is a revised version of something that appeared in: Clayton & Nix, 1987, *op. cit.*

GLOSSARY OF TERMS

A-train: A three or four-vehicle combination consisting of a tractor, a semitrailer, and one or two trailers. The trailers are usually attached to the lead semitrailer or trailer by means of an A-dolly converter (with a single drawbar) that has two points of articulation -- one at the pintle hook and one at the dolly. The standard A-train ("double" or three-vehicle combination) has a total of three articulation points. The special permit A-trains in some provinces ("triples") have five points of articulation.

Axle: A shaft and the wheels on that shaft. See also "single axle," "tandem axle," "triple axle," "tri-axle," and "quad-axle."

Axle Group: Two or more consecutive axles. The term "axle group" may be used to refer to two or more axles connected to a single vehicle; or it may be used to refer to axles connected to different vehicles in a vehicle combination. An axle group may be a tandem axle, two single axles, a triple axle, a tandem plus a single, etc.

Axle Spacing: See "spacing."

Axle Spread: See "spread."

B-train: A three vehicle combination consisting of a tractor and two semitrailers. The lead semitrailer has a fifth wheel permanently attached to its rear. The standard B-train ("double") has two points of articulation.

Belly Axle: A single axle, usually an air-lift axle, which is located ahead of a tandem axle on a semitrailer.

C-train: A three (sometimes four) vehicle combination consisting of a tractor, a semitrailer, and one (or two) trailers. The trailers may be either full double-drawbar trailers (with self-steering front axle(s)) or more typically semitrailers converted to full trailers by means of a B-dolly converter.

Dolly: An A-dolly converter is an axle (or tandem axle) connected to a single drawbar and a fifth wheel which can be coupled with a semitrailer, thereby converting the semitrailer to a single drawbar full trailer. A B-dolly converter is an axle (or tandem axle) connected to a double drawbar and a fifth wheel which can be coupled with a semitrailer, thereby converting the semitrailer to a double drawbar full trailer.

Double: A truck combination with two freight-carrying bodies (platforms, tanks, etc.). "Double" includes a truck-plus-trailer combinations (two vehicles) as well as the standard trains (three vehicles).

Drawbar: A linking device which can be connected to a forward vehicle by means of a pintle hook (or hooks). In this report, and particularly in the background papers, the terms "tongue" and "hitch" are also used to mean drawbar.

Drive Axle: An axle that transmits tractive effort to the road surface.

Dual-tire Axles: An axle with four tires.

Fifth Wheel: A plate with a latching mechanism used to connect a semitrailer to a tractor or a converter dolly. The "wheel" is a (roughly) round plate, lubricated (thereby allowing articulation), with a hole allowing a kingpin to be inserted.

Fifth Wheel Offset: The distance from the centre of the hole in a fifth wheel to the centre of the axle or axle group over which the fifth wheel is positioned. If this fifth wheel is forward of the centre of the axle or axle group, the fifth wheel offset is considered a negative magnitude; if to the rear, it is considered a positive magnitude.

Fixed Axle: An axle connected to a vehicle in such a manner that it cannot steer.

Hitch: See "drawbar."

Kingpin: A metal pin located on a plate mounted on the underside of the frame of a semitrailer which couples with the locking mechanism of a fifth wheel to permit towing.

Kingpin Offset: The distance from the front of a semitrailer to the kingpin.

Lift Axle: (Sometimes an "air-lift axle"): An air axle suspended axle located on a tractor, semitrailer or trailer which can be retracted or lifted from contact with the road.

Other Highway: A highway or a road other than a primary or secondary highway.

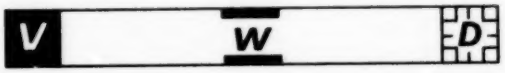
Overhang: The distance from the centre of either the first or last axle in a vehicle or vehicle combination and the extreme front or back of the vehicle; generally referred to as either the "front overhang" or the "rear overhang."

Pintle Hook: A hitching device located on the rear of a semitrailer or trailer which couples to a tow eye on a drawbar.

Primary Highway: The major highways, usually under provincial/ territorial jurisdiction (although there are some federal and local highways that qualify). For here, the major distinguishing feature of these roads is that these are almost always the "highest class" roads in terms of allowable weight and dimension regulations.

Pup: There is no strict definition of a "pup trailer." It is generally used to refer to short trailers or semitrailers in a double or triple combination.

Quad-Axle: Four axles on a semitrailer (four single axles, two singles plus a tandem, a single plus a triple, etc.) with non-equal spacings/spreads and/or with no capacity to equalize loads among the four axles.



RTAC/CCMTA Study: The major research activity of the Roads and Transportation Association of Canada and the Canadian Council of Motor Transport Administrators over the last few years into weight and dimension regulations (pavements, structures, stability, economics). In the text, the term "CTRC report" refers to a summary of the technical findings of this research.

Rocky Mountain Double: A three-vehicle combination (usually in an A-train configuration) consisting of a tractor, a long semitrailer (45 or 48 feet, 14 or 14.65 m), and a short trailer (probably 28 feet). Rocky Mountain doubles of around 29 m in overall length are permitted in four provinces under special permit.

Running Gear: the axles, wheels, suspension systems of a vehicle.

Secondary Highway: Those highways, other than primary highways under provincial or local government jurisdictions. For here, the major distinguishing feature of these roads is that they sometimes are subject to more restrictive weight regulations than are primary highways.

Self-Steering Axle: An axle connected to a vehicle in such a manner that it is capable of a self-steering action in response to side friction forces exerted on the wheels.

Semitrailer: A non-self propelled vehicle used to transport goods, supported in transit by a combination of its own axle(s) and the axle(s) of the preceding vehicle. The connection between a semitrailer and a lead vehicle (truck; tractor, or another semitrailer) is made with a kingpin (on the semitrailer) and a fifth wheel (on the lead vehicle). A semitrailer may be converted to a trailer by the use of a dolly.

Single Axle: An axle which is independently connected to the body of a vehicle and which has no mechanism for equalizing loads with any other axle.

Single-tire Axle: An axle with two tires.

Spacing: The longitudinal distance between the centres of two axles or axle groups. "Inner spacing" refers to the distance between two adjacent axles; "outer spacing" refers to the distance between non-adjacent axles (eg, axles #1 to #4 where two tandem axles are involved). Note that "spacing" is not used to mean "spread."

Spread: The longitudinal distance between the centres of axles within an axle group (eg, a tandem axle spread or triple axle spreads). In the case of triple axles, "outer spread" means the distance between axles #1 and #3.

Steering Axle: An axle connected to the front of a vehicle and steered by a driver in the driver's compartment.

Tandem Axle: Two adjacent axles which are attached to a vehicle at a common point or which have some mechanism for approximately equalizing a load between them.

Tongue: See "Drawbar."

Trailer: A non-self propelled vehicle used to transport goods, fully supported by its own axles. The connection between a trailer and a lead vehicle (truck, tractor, or semitrailer) is made with a drawbar and pintle hook(s). For emphasis, and to ensure the distinction between semitrailers and trailers, these vehicles are sometimes referred to as "full trailers." A semitrailer may be converted to a trailer with the use of a dolly. A "stiff-poled-pup trailer" or a "pony trailer" is a trailer which, because of its axle configuration and construction may transfer weight between itself and a lead vehicle.

Tractor: A self-propelled vehicle with a fifth wheel, used primarily for the purpose of towing a semitrailer (or various combinations of semitrailers and/or trailers). Although the primary purpose of tractors is towing, they may also contain a platform or a van ("drome") which allows some freight to be carried.

Train: The standard train is a three-vehicle combination, consisting of a tractor, a semitrailer and either a second semitrailer or a full trailer. See "A-train," B-train" and "C-train." In some provinces, under special permit, there are also four-vehicle trains which are referred to as "triples."

Tri-axle: Three axles (three single axles, or one single plus a tandem axle) with non-equal spacing/spreads and/or no capacity to equalize loads among the three axles.

Triple: "Triple" is almost always used as a short form for a "triple axle." However, it occasionally is also used to mean a four-vehicle combination.

Triple Axle: Three adjacent axles which are attached to a vehicle at a common point or which have some mechanism for approximately equalizing a load among them. As a general rule, the spreads in a triple axle are equal (ie, the spread from axle #1 to #2 is the same as the spread from axle #2 to #3). In this report, a distinction is made between a triple axle and a tri-axle. The CTRC report refers to these axles as "tridems."

Truck: A self-propelled vehicle with a box, tank, or platform in or on which freight is carried, including permanently connected or mounted equipment. Trucks can be used in combination with one or more trailers (and/or semitrailers). Where there is no possible ambiguity in meaning, the term "truck" is also used to refer to all categories of commercial-freight-carrying vehicles (e.g., "the change in regulations permitted large trucks to operate . . .").

Turnpike Double: A three-vehicle combination consisting of a tractor, a 45' or 48' semitrailer, and a second 45' or 48' semitrailer and/or full trailer. These long combination vehicles are allowed in several provinces under special permit.

Wheelbase: On a tractor or a truck, the distance from the steering axle to the drive axle or the centre of a drive-tandem axle.